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SALT LAKE CITY, UTAH

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LIGHTING FIXTURES
AND
LIGHTING EFFECTS

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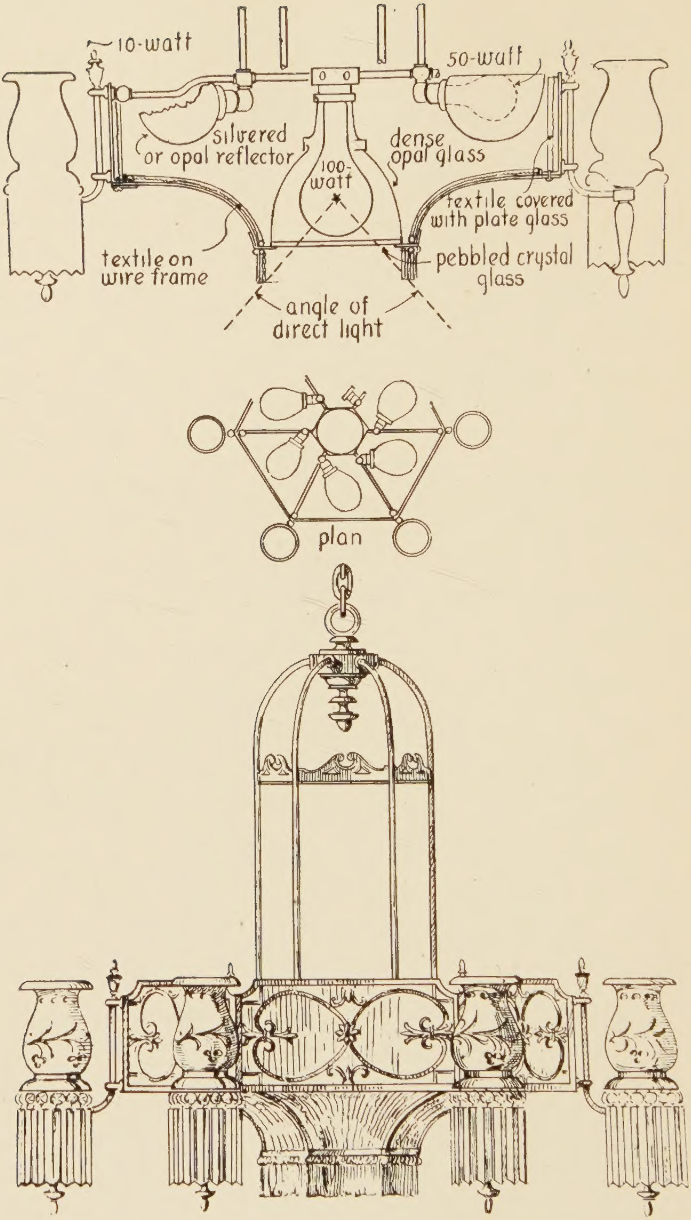

Our control of quality, quantity, and distribution of artificial light is so enormously greater than it was when light-sources consisted of flames, that the designer should celebrate this greater freedom by creating lighting fixtures which utilize these modern possibilities. The accompanying illustration is not an *imitation* of an early Colonial fixture, but it illustrates an *adaptation* of art-forms to a new era of lighting. Such evolution is characteristic of changing civilization and is inevitable.

LIGHTING FIXTURES
AND
LIGHTING EFFECTS

BY

M. LUCKIESH
Director, Lighting Research Laboratory, National
Lamp Works of General Electric Co.

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PREFACE

Artificial light throughout the ages was produced by feeble flames, which accomplished little more than to make darkness visible. Owing to the nature of these sources, little control over artificial light was possible, but scientific research during recent years has greatly reduced its cost and at the same time has enormously increased its potentiality. In other words, artificial light from powerful modern sources, enclosed in glass bulbs, has shaken off its handicaps of yestercentury. Now it may be adequately controlled in quantity, quality, and distribution, but the great possibilities of this almost unlimited control and the many new applications are appreciated by relatively few persons. This lack of appreciation is due not only to inexperience with modern light, but also to a persistence of the acceptance of limitations which became established during the many centuries when artificial light did not possess its present possibilities.

One of the many proofs of a lack of appreciation of the great potentiality of modern artificial light is the general practice of adapting the fixtures of former periods by merely substituting electric lamps for the flames of the past. It is true that these simple adaptations have many applications in modern interiors in which we like to reproduce some of the spirit of bygone centuries. However, even in these cases the art of the past should be modified to suit as perfectly as possible the powerful light sources of the present time. Eye comfort demands that shades and diffusing media be supplied where they were unnecessary when flames of low brightness were used. Furthermore, we should progress in the use of artificial light, just as we try to do with other gifts of modern science.

The control of light has been well developed in the primarily utilitarian fixtures available for commercial, industrial, and street lighting, but this cannot be said of most so-called decorative fixtures. One of the primary aims of this book is to show that decorative features do not necessarily inhibit the incorporation of the scientific control of light. Systematic discussions and many suggestions are presented in support of this contention. The author realizes the infinity of art forms and the variability of taste, and does not claim esthetic perfection in the illustrations which are presented. Decorative clothing has been supplied for the scientific framework in these cases only to the extent necessary to indicate that Science and Art may be wedded in fixtures as in other objects. Any reader may supply the art forms which he desires.

Another primary aim of this book is to extend further the idea of light as a medium of expression, an idea which the author has developed in various demonstrations, installations, and writings. Almost unlimited control over artificial light has added a new powerful medium to those which we have used for centuries in making our interiors interesting and charming, and this new medium has greatly extended the possibilities of making the interiors express the moods which suit us or the occasion. In this direction the appearance of the fixture becomes of secondary importance as compared with the lighting effect. However, fixtures, when visible, are always important. For this reason, a number of chapters are devoted to them and it has been necessary even to attempt to give an idea of various period styles and the conditions under which they developed. The discussions of these viewpoints lead us far afield into extensive realms which cannot be completely encompassed in a single volume; however, as much space has been given to them as possible. Designers, manufacturers, and salesmen of fixtures, as well as lighting specialists, householders, and even general readers, should profit by a knowledge of these phases of art and of artificial light which these limited chapters may supply.

The illustrations of art forms of various periods have been confined as much as possible to lighting devices and to such objects as vases and architectural details which may now be useful in connection with lighting equipment. From this viewpoint and, particularly from that new one which treats light as a medium of expression, this book should be helpful to architects, interior decorators, display artists, and also to those interested in the attractiveness of stores, shops, hotels, restaurants, theaters, dance halls, and other places where the new possibilities of artificial light may be utilized.

The author wishes to acknowledge his appreciation of the skill and interest of Mr. B. L. Miller, who made the original drawings, and to Mr. E. W. Commery for helpful criticisms and suggestions.

M. LUCKIESH.

NELA PARK,
CLEVELAND, O.

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LIGHTING FIXTURES AND LIGHTING EFFECTS

CHAPTER I

THE POTENTIALITY OF LIGHT

The earliest primitive beings accepted things as they found them. Bits of colored earth, glittering pebbles, colorful stones, and metallic fragments were gewgaws admired only for themselves. But through countless centuries these objects evolved into media for artistic expression. Beings bedecked themselves with these baubles and, through combinations ever increasing in complexity, laid the foundation of the art of jewelry. Groupings of glittering and colorful fragments were the forerunners of Oriental inlay and of the mosaic art of Byzantium. Doubtless, bits of colored glass were first treasured as semi-precious gems. Certainly, there is a great gulf between such a primitive interest in these specific objects and that interest in glass as a medium of expression which eventually gave us the stained-glass windows of Chartres Cathedral. Likewise, it is a long step from primitive admiration of a fragment of marble to the classic sculptures of the Parthenon, or to that most beautiful structure itself.

The crude outlines which early beings scratched upon the walls of their caves or huts were at first colorless, but, as these beings ceased to be interested merely in the bit of colored earth as such, they filled in the outlines of their drawings by applying this natural pigment. Without this step the divine paintings of Raphael would not have come into being and the great art of decoration would have lacked what painting has brought to it. Vegetal and animal life yielded their juices and the art of dyeing appeared. Dyed ornaments of wool existed ages before the mythical weaving of Penelope or the wonderful Gobelin tapestries became realities. And so it was with all the materials of the arts. Throughout civilization we find interest, which at first is solely in the specific objects, gradually evolving into an interest in the uses of these materials as media of expression.

During all these centuries in which various materials were evolving into media of expression, artificial light also played a minor rôle. Until recently, however, interest did not pass the stage of the specific object. Throughout past ages artificial light sources have played important rôles in ceremonies and in interior decoration. Owing to the nature of the light sources, which were open flames until recently, light itself was limited as a medium of expression. However, with the advent of the electric-filament lamp, in which the light source is completely confined in a glass bulb, the potentiality of light as an expressive medium very greatly increased.

But even this is not an adequate explanation of the lack of recognition of the powers of light when we consider the countless examples of the influence of light on the expressions of objects and upon the moods of interiors which have confronted mankind throughout the ages. It seems not too much to expect to find man awaiting eagerly the time when artificial light could be completely controlled in distribution and in color and adequately supplied at low cost. This time arrived ten years ago, but relatively few persons have appreciated its potentialities. The situation is like that of earliest painting. Scientific knowledge refined the natural colored media and gave the modern painter and decorator a wonderful palette of pigments and dyes. Likewise, science improved artificial light, so that it is now inexpensive and controllable. But here the parallel ceases. Artists were prepared for using the improved colored media; the lighting artist must be developed.

If we pass by for the moment the new conception of light as a medium of expression and consider only the influence of light and of lighting in our interiors, we are still surprised that light is so little appreciated. All arts which we enjoy visually are dependent upon light. A sculpture is modeled by the lighting. A painting is colored by the light which falls upon it. The sculptor uses his tools to produce a contour which the lighting models. He cannot even fix the expression, for it varies as the lighting varies. The painter applies the media of his art, but the color is in the light which falls upon his product. Like the sculptor, he can only fix the outlines, for the values and the colors change with the lighting. The decorator applies his color scheme, but he cannot fix it. The mood or expression of the interior depends upon the quantity and the quality of light which reaches the various surfaces. The colors and the values change with the lighting. The architect who harmonizes and blends various arts cannot avoid the influences of light and of lighting. Diffusion, direction, distribution, and color of light all play important parts in the final appearance of an object, a room, or an exterior. The lighting artist is not only able to control light so that the appearance of an interior or even its mood is as he desires it to be, but with primary light he can do much that cannot be done otherwise.

Doubtless, many persons will agree with much of this through their observations of Nature's lighting effects, but they cannot be expected to appreciate the potentiality of controllable artificial light without having had an opportunity to experiment fully with light as a medium of expression. Such an opportunity has been presented to few persons as yet, but as one of the fortunates the author is attempting to present his analyses and experiences—hence, this book, which at best cannot do justice to the subject. The subject can be adequately presented only through the medium of light; the medium of words is inadequate. But, in order to transmit the thoughts to others, we must do the best we can in describing this medium in terms of another medium which is transmissible.

One cannot watch the sunsets without noting something of the expressiveness of light. Likewise, by viewing a familiar landscape throughout the day and on different days he cannot fail to note many expressions and moods. The charming spell of dawn with its faint diffused light and its deep, indefinite shadows merges into a gayer mood as the sun rises. The elongated shadows are now defined; objects are well modeled; still there is diffused light from the sky which subdues the shadows. The sun mounts toward the zenith; the shadows shorten and they grow harsher. The mood is far different from the earlier ones. One even may associate such harsh abbreviated shadows with the unpleasant heat of midday. We carry our experiences with Nature into the interiors of our houses. We cannot escape the fact that we are Nature's beings and that the light and the lighting effects outdoors have not only laid their imprint upon us, but also upon our countless ancestors.

The sun passes the meridian and the shadows lengthen. Usually, the landscape becomes more interesting, until finally the mood of sunrise is repeated at sunset, but it is modified by our thoughts and our attitude. Sunrise was full of promise. The day is passing. Has that promise been fulfilled? Have we made this day worth while? Thus, our own mood alters slightly, at least, the mood of Nature. Twilight arrives, and finally its veil is complete, except for the stars which pierce it. Other moods are these. In fact, the day outdoors is a pageant of moods, one modulating into another. Variety is also introduced by clouds, for when a cloud suddenly obscures the sun the well-defined shadows disappear. The shadows now are indefinite and objects are not strikingly modeled. The same setting on an overcast day loses much of its interesting variety. This alone teaches us that we want shadows in some interiors—not harsh, deep shadows, but those of Nature's landscape near the end of a sunny day.

Architects for many centuries have recognized the effect of lighting on ornament outdoors, and the evolution of ornamentation has been influenced by Nature's lighting. It would be an interesting task to unravel all the details of this influence, but it must suffice to comment briefly upon this phase. After all, this thought is introduced solely for the purpose of emphasizing in another manner the importance of lighting. It is obvious that architectural ornamentation was developed for lighting from above. Cornices, capitals, moldings, and various projections and recesses perform the function of introducing shadows. The architect creates lines and areas of light and of shadow where he desires them. Ornament is devised with this in mind. The dentil which is common to Ionic and Corinthian cornices seems to be representative of beam ends. But it is now used largely to break up or to temper the horizontal shadow which would be dark, harsh, and conspicuous without it. In sunny climes there is evidence of a daintiness of ornament and a shallowness of relief as compared with regions of greater cloudiness. In the former case the intense sunlight and relatively little sky light would cause undue harshness and darkness of shadows in the deeper ornamentation.

Anyone who has practiced photography with the eye and the patience of the true artist, will testify to the changing moods and expressions due to Nature's lighting. A building, a landscape, a seascape, or, in fact, any outdoor setting will have the desired appearance at a *certain* time of the day on a *certain* day. One must have the will to rise early, the patience to wait long, and the eye to detect the right moment, if he is to utilize the powers of natural lighting in photography. Similarly, the photographer, the painter, and the sculptor can do much with the lighting of their subjects if they know the powers of light and how to utilize them. Handling light is a matter of study and experience, just as is the use of clay or of pigments.

Fireworks furnish us with some of the pure gems of light. The bursting rocket is a jewel of light, and as such it exemplifies the powers of light in this direction. For some reason this brings to mind the stained-glass window, which is rich and gorgeous beyond a painting done in reflecting pigments. From the viewpoint of light, the distinction between an opaque painting and a transparency is interesting. A white paint reflects only about thirty times more light than a so-called black paint. This is the extreme contrast which is obtainable in a painting which is to receive approximately the same illumination over its entire area. It is utterly impossible for a painter to represent things as they are in respect to brightness and color. Fortunately, this is not the primary aim of the master painter; nevertheless, this fact emphasizes the limitations of pigments viewed by reflected light. Let us refer to them as secondary lights. The painter not only cannot render the high lights in a jewel in relation to the low lights, but the range of values on his palette cannot truly reproduce the light and the shade of any setting except a flat area.

On the other hand, there is relatively no limit to the range of contrast or of value obtainable by a transparency. The lowest value may be actually black and the highest one is only limited by the brightness of the light source behind the transparent portions. Transparent colors may be purer than those viewed by reflected light, because there is always some light in the latter case which is reflected without being altered in color by the colored surface. Obviously, the stained-glass window could be reproduced on an opaque surface by projecting an image of a small transparency in the manner of lantern-slide projection; that is, by varying the amount and the color of the light which various portions of the surface receive, any range of brightness or of value may be produced. This is another illustration of the potentiality of light. In an interior, it is not difficult to control light in such a manner that various areas receive greatly different amounts of light. This is particularly easy to accomplish in ornamented interiors, where the architectural features conceal the light sources or confine the light to panels, columns, friezes, and other areas. An interesting example of the foregoing is easily produced by projecting the image of a positive transparency (a lantern slide) made from a negative photograph of a painting upon and coincident with the painting itself. It is seen that the high lights of the painting will receive a great amount of light through the more transparent portions of the lantern slide. Conversely, the low lights or shadows of the painting will receive little light through the more opaque portions of the lantern slide. The effect of the greatly increased contrasts or range of values produced by this non-uniform lighting is very striking and it gives a further idea of the possibilities of light.

In interiors, many moods or expressions may be created by controlling the distribution and the color (quality) of light. This is easily demonstrated in the living room of the average home, if it is equipped with portable lamps and a ceiling fixture. Of course, it is more strikingly demonstrated in a room equipped for the purpose. Flood the room with indirect lighting and we have a far different expression than when the light is confined to the table top or to one or more spots, as is the result when common portable lamps are used. No decorative scheme can accomplish this, because light alone is mobile. Adding to the many distributions of light the gems of lighted ornament, such as chandeliers, wall brackets, and decorative portables, a vast array of lighting effects are possible in a single room. Then we may introduce color into the lighting with additional variety and effectiveness. Truly, light is a wonderful medium which expresses much.

We may also introduce interesting high lights by confining a certain amount of light to a sculpture, a painting, or any ornament. Transparent wall plaques, artificial windows, and even decorative skylights may be illuminated by light of any tint or intensity.

These and many other possibilities await those who would draw upon the potentiality of light. Within recent years tremendous strides have been made in the development of equipment for controlling the color and the distribution of light, so that at the present time it is easy to do with standard equipment what could be done a few years ago only with makeshift or specially constructed reflectors, refractors, and colored accessories.

Perhaps the most potent characteristic of light is its mobility. No other medium of expression utilized by the architect or the decorator possesses such a characteristic in any appreciable degree. By means of electric switches, the lighting effect may be altered instantly, assuming, of course, an installation of lighting equipment designed for the purpose. One switch may control lamps which shed their light over the upper portion of a room. Another circuit may not alter the distribution of light, but merely the tint. Such a change is one of the simplest in lighting, but the change is so subtle over every object and area in the room that it would tax the decorator's patience and genius to produce this change in many weeks. With lighting, the changes may be made instantly. Painting with light will some day be a wonderful field for the lighting artist.

Another circuit may confine light to a certain area. Now a restfulness has spread over the room and the high-lighted spot invites one to a lazy hour of reading. What a different mood this is from that produced by the general lighting! Colored or colorless light may escape from a cove or from corbels in which light sources are concealed. These and many other effects may be available in one room. They are not to be used kaleidoscopically. They are there to suit the mood or the occasion. As the interior becomes more pretentious, the possibilities increase. The public hall or the theater may have its startling variety of effects. The church may have several lighting effects to meet the moods or the needs of its various occasions. The ballroom may have suitable gay, colorful, and glittering effects. The restaurant may have restfulness or gayety. The lodge room may have dramatic or frivolous effects, to suit the occasions. The monumental interiors may be given the finishing touches of majesty or of splendor by controlling light so as to emphasize various areas or ornaments. In most interiors, light has many possibilities as a medium of expression.

Color schemes in interiors are often devised for their psychological effect. The decorator applies the color to great areas and with good results. Here, again, primary light reveals its powers by comparison with the secondary light reflected from walls, ceiling, etc. When we use colored light for the same purpose, the light modifies the color of everything, and therefore is a powerful psychological factor.

Thus, lighting assumes a new significance beyond that of mere light sources and lighting fixtures. It is a new art of lighting, because until very recently artificial lighting was supposed to be merely a matter of lighting fixtures. Ask a person to appraise the lighting of any interior and he will confine his attention nearly always to a consideration of the lighting fixtures. It rarely occurs to him to analyze the lighting effect—the influence of light on the appearance or the expression or the mood of the room. The new art of lighting is a change in viewpoint. It is a consideration of light as a medium of expression and not merely an admiration of the light sources.

In respect to light, we are just now in the position of those primitive artists of long ago who turned their attention from the colorful baubles themselves to their use in mosaic art. We are traveling the road that was traveled ages ago by those who admired the bits of colored earth, but also began to paint with them. Our interest in light is changing from merely admiration of and interest in light sources and lighting fixtures to that of artists interested in the material—light—as a medium of expression. We are beginning to paint and to model with light. Viewed from the standpoint of decorative and, more broadly, of psychological possibilities, the modern light source is Aladdin's lamp, indeed. There is nothing mysterious about this lamp, but with the many examples of the expressiveness of light which have confronted us on every hand for ages is it not mysterious that we have scarcely recognized the possibilities of modern controllable light?

CHAPTER II

THE INFLUENCE OF NATURE

The science of psychology is comparatively new, particularly in its experimental aspect, but it has already proved its great importance in human affairs. It is true that the term "psychology" is much abused and that many charlatans have used it in such a manner as to cast doubt upon this very promising science. The study of mental life is engaging the attention of many brilliant men and women in aspects far beyond the conception of the layman. Scientists realize that only a promising beginning has been made in this complex field notwithstanding the cocksureness of the many quacks who make unwarranted pretensions.

In the field of light and color, the least explored field is that of psychology. This phase of the use of light and color is so important, however, that we must do the best we can with the few threads which have been unraveled from the tangled skein. Besides these well-established facts, we must be content for the present with conclusions which we may draw from various excursions into highways and byways. With this understanding, let us approach the subject. Let those who disagree with any of the statements which follow modify them to suit themselves. It may be well to realize in doing so, however, that most of the facts of the psychological effects of light cannot be established by the opinions and the reactions of one person. We need for this work an "average" person, but such a one cannot be chosen until we have determined what represents an average person. Therefore, researches into the psychological realm must deal in most cases with many persons. The conclusions in these chapters are based on data drawn from the reactions of many persons. Other conclusions are based upon philosophical analyses. In such cases the philosophy is presented, to be accepted or declined as the reader chooses.

Some very obvious effects of light and color are often ignored, notwithstanding the fact that they are fundamental in many applications of these media. Light is stimulating or distracting and darkness is restful or depressing, depending upon conditions. If we desire to rest, to think, or to read, we do not choose a place on the roof in the daytime or a room ablaze with light. If we are wise, we seek restfulness in a dark or dimly lighted room. When we desire to read effectively, we choose a well-lighted spot, such as that near a portable lamp, which is hemmed in by moderate shadow. Notwithstanding this, we find reading rooms in our homes and in public places showered with light over their entire areas. The living room is a domain for portable lamps which supply inviting places for restful reading or conversation. The same is true of our public rooms of a similar nature, although in many of these places the localized light may best be supplied by "fixed" equipment.

Let us take the converse case. The ballroom is an appropriate place for lighting of a stimulating character, and even for glittering effects. If we ask why we like jewels and silks, we find that we like their glitter. Diamonds would have little vogue if we had to view them always under an overcast sky or in a room lighted in the same manner. The same principle holds true in the public dining rooms. Where fine gowns are worn by bejeweled ladies, general lighting solely from concealed sources is not best. In fact, careful study has revealed that, in various places of this kind, such lighting is unpopular. Glittering light sources, such as crystalline chandeliers, must supplement general lighting from concealed sources if we are to be satisfied with the appearance of things which should glisten. On the other hand, there are dining rooms, very fortunately, which are designedly places for restful eating and conversation. Subdued lighting in such cases is the most suitable. In any case we like some localized lighting from small portables on the table because this aids very much in holding our attention.

Now let us consider our own dining rooms. The table should be the center of interest. It cannot be so unless it is the high light of the room. Light concentrated on the table by a suitable pendent fixture, by small portables, or by shaded candles produces the desired effect. Now we are interested in the circle of family or friends. We are hemmed in by the semi-darkness. We have the charming effect of the campfire. Is this an inheritance of more primitive ages? Surely, psychological powers of light were not necessarily inherent in light originally. Our experiences and those of our ancestors must be responsible for much of our attitude toward light and color.

In the preceding chapter we had a glimpse into Nature's lighting. Let us inquire further. The human race evolved outdoors under the light from a single source—the sun—and a lesser amount of light from the sky and the clouds. The sunny day is cheerful. In proof of this let us recall those long periods of dreary days in winter or our enforced abode on the north side of a hotel or apartment building. The overcast sky is depressing. At best, the lighting effect is uninteresting. A study of any landscape is convincing.

It is interesting to inquire why the sunny day is cheerful, but the answer does not alter the fact. The sun is beneficial in many ways. Is the perpetual consciousness of this so ingrained in our minds that we are no longer conscious of this attitude? Nearly all primitive beings have held the sun in high esteem. Are the same reasons for this devotion responsible for our feeling of cheerfulness when the sun shines?

Overcast days should affect us in a manner quite opposed to sunny days and, in fact, they do. Is it because of the absence of sunshine or is it due to the fact the overcast skies are associated with stormy weather? Surely, rain is as essential as sunshine. Of course, we do like a shower (if it does not overtake us unprepared), but we do not need long-continued spells of cloudiness to supply us with the rain needed. The student of light or the lighting artist will find such lines of thought fruitful of much which is useful to him in utilizing light as an expressive medium.

If we go further into an analysis of Nature's lighting, we find on a sunny day most of the light is direct light from the sun and about one-fifth of the light comes from the large area of sky. A similar effect is produced in a large room with ceiling and walls of a high reflection factor, in which a single light source is suspended in a frosted-glass shade. This would not be considered satisfactory lighting. This leads us to conclude that Nature's lighting may be improved upon. This is true because Nature's environment is a compromise of many factors. But we must not ignore the great fundamental impressions which have been bestowed upon the human race if we are to have a broad understanding of our reactions to artificial conditions. In the first place, the artificial lighting effect just mentioned is similar to that of a sunny day, but it is not the same. The intensity of illumination, that is, the quantity of light outdoors, is hundreds of times greater than that produced by the artificial light source. Under these conditions the shadows are less annoying outdoors than is the case indoors. Furthermore, the sun is so very bright that we do not dare look at it. We turn our back to it. If we do this in the case of the artificial lighting, the condition becomes less unsatisfactory. It is also interesting to note that our appraisal of the sunny day involved merely psychological effect and the matter of serious visual work, such as reading, did not enter, as it likely does into a consideration of artificial lighting. Finally, our attitude outdoors is quite different from that indoors. Thus, in several respects we are two different beings under the two conditions.

Indoors in the daytime we usually desire daylight if we can have it. When it is insufficient, we supply ourselves with artificial light. This yellowish artificial light does not seem satisfactory when we can compare it directly with the white sunlight. If we do not alter any of the conditions as the daylight wanes, we may be quite satisfied with the artificial light after daylight has faded out completely. Of course, there are minor factors, such as differences in distribution and in color, but we cannot wholly explain this except by a change in attitude.

At night in our homes and in similar places we do not desire white light, that is, light of daylight quality, when we are engaged in recreation. We like the yellowish artificial light; in fact, we usually desire light of a very warm tint. This may seem to be inconsistent, but is it? In our everyday work we are accustomed to daylight. Then we are day beings or work beings. Man did not start to climb the ladder of civilization until he learned to use fire. This gave a light of a warm or yellow-orange tint. Thus, the light of flames has been associated with home and recreation throughout the course of civilization from the earliest caves or primitive huts. Therefore, it is a natural illuminant in its place, just as daylight is for day work. Psychologically, in respect to light, it seems fair to assume that we are two beings—one at night in the cheer, comfort, restfulness, and protection of our homes, and another in the course of our work in the daytime.

We may carry this thought somewhat further for the sake of emphasis. Most of us are likely to enjoy an afternoon ball better under artificial light with its warm tint than when daylight is pouring through the windows. Such an affair is recreational and is associated with night or artificial light. On the other hand, experiments indicate that persons working at night prefer artificial light of a white or daylight quality. Thus, our attitude is influenced by what we are doing. Such facts must be understood if we are to appraise lighting correctly and are to use light most effectively as an expressive medium.

Now let us consider briefly the distribution of brightness or values in Nature. Aside from the sun and its mirrored reflection, the brightest areas in a landscape are sunlit clouds. Nothing can be brighter which reflects light diffusely. Then we have the great area of the sky, which is of a brightness usually much greater than that of the earth or vegetation. This has been the condition not only through countless ages of human ancestry, but also down through the eons of evolution of lower forms of life. Is there any wonder that we have become best adapted to such a distribution of brightness physically, physiologically, and psychologically? The human being developed an extended forehead and projecting eyebrows to aid in protecting his eyes from brightnesses too great for comfort. Excessive brightnesses below the horizontal, such as sunlit snow, are annoying and discomforting. The retina is not used to such brightnesses over certain areas. Psychologically, we became adapted to these "natural" distributions of brightness. Is it a matter of accident that our restful and satisfying interiors are generally brightest in the upper portions, such as the ceiling, and darkest in the lower portions? Did the interior decorator originate this general decorative scheme? It seems more plausible that these are accepted because they are *just natural.*

This brings to mind the suggestion that if we want to produce startling lighting effects—not for comfort and general satisfactoriness, but for their striking character—it is well to consider the unnatural. In other words, we may turn Nature's scheme upside down by reversing the decorative scheme and then introduce lighting effects that are contrary to Nature in distribution and color of light. These will be the most powerful effects that can be produced, but their power will be due to their unnaturalness.

One of the most striking and convincing examples of our adaptation to the environment of Nature is the fact that average daylight or noon sunlight is approximately colorless. It is true that the sun or a sunlit cloud appears yellowish in hue amid the surrounding area of blue sky. This is largely due to the phenomena of color contrast, however. A white paper appears practically colorless when illuminated by average daylight or by noon sunlight. The radiant energy from the sun is of many wavelengths. Only a short range of these produce a luminous sensation. If we separate these radiations into a spectrum, the eye sees many hues, the principal ones being violet, blue, green, yellow, orange, and red. Our visual apparatus is analagous to a radio receiving set which is tuned to respond only to a certain range of wavelengths. Beyond the violet is the invisible ultra-violet; beyond the red is the invisible infra-red. A white surface appears colorless only when the visible radiations of various wavelengths are present in the proper proportions. It is the most natural consequence that our visual organs evolved in such a manner that the combined effect of average daylight or of noon sunlight produces a colorless sensation. In this case, noon sunlight is specified, because in densely populated areas sunlight near the ends of the day becomes yellowish and even reddish in color, due chiefly to the smoke of civilized activities. Out in the great expanses where the atmosphere is clean this effect is not conspicuous and the sunrises and the sunsets are colored only slightly by the natural haze of dust and particles of water. Under these conditions daylight is approximately white throughout most of the day.

In this connection there is another interesting fact. The temperature of the sun is such that the wavelength of maximum radiation (after being modified by passing through the earth's atmosphere) is approximately coincident with that for which our visual organs are most sensitive.[1] In other words, our visual organs have evolved so that they not only see total daylight as colorless, but also are the most efficient for utilizing daylight in this manner. No more eloquent arguments for the influence of adaptation to environment can be summoned.

When we consider the colors and their distribution in natural environments, we find much of interest, although it is necessary to consider so many aspects that we are confronted with a complex task in analyses. Doubtless, our mental attitude toward color had its beginning in Nature, but, of course, usage of color in the artificial world of civilization has contributed many influences. This usage was governed by taste, culture state of prosperity, and various technical considerations. Our present attitude is based upon many factors intricately interwoven into a complex fabric. In fact, it appears at first more like a tangled skein, but if we proceed carefully we are able to unravel some of the threads.[1] Let us confine our attention to Nature for the present and leave other phases of the psychology of color for other chapters.

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[1] Luckiesh, M., "Color and Its Applications," D. Van Nostrand Company, 1921.

The sky is commonly the greatest area of color which confronts us outdoors. On clear days its color varies from a fairly deep-blue to a very pale-blue, but it never approaches in purity the blue of the spectrum or even of a pure pigment. The association of this *color* with the sky has naturally led to the association of this color with the *characteristics* of the sky. Coolness is often experienced in connection with heights, and it is natural for us to associate coolness or even coldness with the atmosphere or sky. Areas of water reflect the image of the sky and water itself is blue-green in color. Surely, bodies of water are very generally cold. Is it not probable that these associations have had a great deal to do with our appraisal of blue as a "cool" or a "cold" color?

Blue is a "retiring" color. Doubtless, a certain optical effect in the eye, known as chromatic aberration, has something to do with some of our striking experiences of the retiring nature of blue. However, it seems plausible to trace this attribute, in general, to Nature. The sky to us has great depth. It represents the distant and even mid-distant portions of landscapes and seascapes. The bluish atmospheric haze is a rough measure of distance which we are unconsciously using in our judgments outdoors.

Under certain conditions blue is a tranquilizing color. Why not? What is more serene than a blue sky? Furthermore, this blue sky with more or less clouds is an ever-present component of outdoor scenes on a sunny day. All the colors of Nature's areas and of the artificial structures of mankind find the blue sky hovering over them as a part of a setting. If this is harmonious, it is not premeditated on Nature's part. It is superficial and silly to consider that Nature was colored to please us. We are insignificant in Nature's scheme. We are here because of adaptation to natural environments. In the process of adaptation, mental attitude has been influenced as much as our physiological processes and our physiognomy. Since the blue of the sky is so dominant in position and so often present in the great variety of Nature's settings, it is natural that we have developed a feeling of neutrality or tranquillity toward it. This may be responsible for the fact that blue is often considered a harmonizing color.

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[1] Luckiesh, M., "The Language of Color," Dodd, Mead & Company, 1918.

Under some conditions, particularly of dark shades or of low brightness due to low illumination, blue is depressing. Of course, under low intensities of illumination all colors decrease in vividness and liveliness. The same result is accomplished in the use of pigments by mixing black with them. The suppression of the powers of colors by diminishing their brightness is worthy of consideration, but the specific depressiveness of blue in comparison with other colors must have some other explanation. Shadows on a sunny day receive their light from the sky. Therefore, a colorless surface will appear bluish or the color of sky light. All surfaces in shadows will be more or less affected. Ordinary shade suggests coolness, which may aid in establishing the attribute of coolness for blue. The deeper shadows are those of Nature's solitudes. Is it not possible that these facts have had something to do with the coolness, tranquillity, melancholy, or even depression which blue seems to inspire under certain conditions?

Our experience with green in Nature is confined to vegetation. Here we have great areas of greens. These are very generally medium shades, varying in hue from bluish-green to yellowish-green. Outdoors, the vegetal areas immediately confront us in the foreground and middle distance. It is not surprising that green should be more or less neutral in its effect upon us, particularly in the moderate shades. The human race has been more intimately and generally exposed to vegetal green than to any other color throughout the ages. Of course, it would be interesting to investigate the reactions of the Eskimo to colors. Such a study might reveal interesting data. However, the neutral character of green is fairly well established for civilized races, although it should be emphasized that the greens of Nature are far from saturation or high purity. They are toned down with gray, in general; that is, they are shades of impure green. Nevertheless, our artificial colored media are also impure, although they may be produced of greater richness of color than vegetal greens. Such brilliant greens cease to be neutral. They partake of the characteristics of blue or of yellow, depending upon the proximity of their hues to these spectral neighbors. A pure, brilliant green also has a certain liveliness which removes it somewhat from the neutral zone of Nature's vegetal greens.

Here, again, we have interesting associations which have left their imprint upon our attitude toward this color. Green is the color of living vegetation. In this sense, there is promise and hope, and eventually the bounty of harvest. Naturally, green is symbolic of youth and vigor. As a mark of living things, it becomes symbolic of memory. In passing, it is interesting to note that in early spring many of the tender greens are of a delicate yellowish tinge compared with the deeper shades of summer. Even these variations are effective in the modeling of our attitude.

Yellow is another color which has acquired some of its psychological effectiveness through our contact with it and its variations in Nature. The sun is colorless at noon and throughout a large part of the day; nevertheless, it is generally considered to be yellowish. It is described and represented as being a warm yellow. The sun is usually seen amid a more or less bluish field of sky. If we view a white or a gray paper upon a bluish background, the paper will appear a yellowish tint, complementary to the background. This effect of color contrast is purely psychological, or at least psychophysiological. It accounts partially for the general idea that the sun and sunlight are yellowish in color. As the sun declines toward the horizon, it actually assumes a yellowish tint, due to atmosphere absorption. Furthermore, its brightness often becomes reduced under these conditions sufficiently so that it may be looked at without great discomfort. Therefore, when we are able to look at the sun with unprotected eyes, it not only appears yellow, but when nearing the horizon is actually yellow, orange, and even red. Sunlit colorless surfaces, for the reason of color contrast, also appear yellowish in comparison with the actually bluish shadows (due to skylight) during midday. Thus, there are adequate reasons for associating the properties of sunlight with yellow, and this color naturally has acquired the attributes of light, warmth, and cheerfulness.

Throughout the ages man has associated yellow and orange and intermediate hues with the flames and the glowing embers of burning material. The play of flames and embers provides a great variety of colors, from light-yellow to deep-orange. Heated metals and glowing coals are often red. These influences added much to the powers of the so-called "warm" colors. It is not surprising that yellow, orange, and light-red are stimulating, because they are associated with heat, light, and energy.

Yellow possesses the conspicuous property of being the most luminous color. Therefore, flowers of this color appear bright and lively amid their relatively somber environments. Orange also acquires the same characteristics, because it may be considered to rank next to yellow in luminosity among the colors common to vegetation. The most conspicuous colored flowers in Nature are those of the warm colors—yellow, orange, and red—not only because they are relatively brighter than their green backgrounds, but because they differ very greatly in hue from the variety of greens with which they are associated.

If we look over Nature's scenes, we conclude these colors are relatively very rare in area and therefore they should be more or less stimulating. In their variety of tints and shades they are predominant in the foliage, flowers, and fruit of the harvest season. Red is the color of meat. These associations with food and with Nature's bountiful harvest doubtless are partially responsible for the stimulating influence of these colors. Red as the color of blood is also responsible for some of the peculiar power of this color.

The lighting and coloring characteristics of the various seasons have had their influence upon our attitude toward light and color. Spring is the infancy of the year, full of promise. It attains vigorous youth as it merges into summer with deepening greens. As summer proceeds, the yellowish and brownish tints of autumnal maturity appear. Then the harvest is heralded by a riot of color. Nature has spent herself and must recuperate. The brilliant colors of late autumn gravitate to a variety of browns which continue to fade into the drab tertiary colors of early winter. In colder climates a blanket of snow appears and the barren trees are silhouetted against a leaden sky. But there are lively days of sunshine and the evergreens under their mantle of snow assure us that Nature is merely asleep. There is life and there is hopeful promise. The icy blasts give way to warm breezes. Spring is in the air. What a buoyant feeling! The snow leaves and the delicate greens complete the cycle of the year. The march of the seasons and their characteristics have had much to do with establishing the language of light, shade, and color, and an acquaintance with such byways is the necessary foundation for the development of the lighting artist.

Vivid colors occur in Nature's settings only in relatively small areas, such as in flowers and fruit. All the surroundings are painted with colors subdued with gray. Nature is somber indeed as compared with a brilliant flower, but it is charmingly colorful, as is demonstrated by noting what the ordinary photograph "leaves out." Compare the ordinary photographic print with the image of the original as seen on the ground glass of a camera. Nevertheless, notwithstanding the colorfulness of Nature, this coloring is of a very subdued character. In our artificial world, dyes, pigments, and colored lights can supply us with extremely colorful effects, eclipsing Nature. This is one of the great advantages of artificial light, but these powers are dangerous unless they are understood. We may improve upon Nature's lighting and coloring, but for those places in which we are to live restfully the departure should not be too great. On the other hand, where thrill, novelty, variety, and stimulation are desired, a departure from natural conditions is the most effective means. Both viewpoints should be based upon an intimate knowledge of the outdoor environments which cradled our bodies and our minds.

The lighting effects outdoors and the consequent distribution of brightnesses or values can be reproduced indoors only by artificial light. Here the powers of light are well demonstrated. Perhaps the most fascinating phase of Nature's settings is the variety of lighting effects. Nature's lighting is ever changing. Most of us pay little attention to this charming phase of the outdoors, except for sunsets. Even these are consciously seen and admired by few persons. The sky is the ever-changing portion of the landscape. It is of much interest at all times, but toward sunset it becomes fascinating. Here nightly are rendered the great symphonies of light and of color. The sun and its cohorts, the sky and the clouds, give us a great concert each day. The program is altered daily. The gentle strains of dawn may be sad or promising. A variety of moods may be displayed before the great swelling crescendo is reached toward sunset—if this is Nature's mood. Then the diminuendo sets in until the final plaintive notes of light and of color fade into the twinkle of stars—if this is Nature's mood for this night.

Artificial light is the only medium in which we may reproduce this great charm of Nature. Pigments are weak, inadequate media for representing Nature. Aided by artificial light, they increase their usefulness, but their effects are fixed. Not only does light possess greater powers than pigments (which are secondary lights), but it has a monopoly upon the property of mobility. Artificial light is a mobile medium of expression. With it, not only may any of Nature's effects be reproduced, but the great pageant of lighting moods may be simulated with the same modulations. These lighting effects are just beginnings for artificial light. The possibilities beyond them and into the realm of the abstract are unlimited.

CHAPTER III

THE IMPRINTS OF USAGE

As we traverse in our imagination the pathway along which civilization has struggled for countless centuries, we find many interesting usages of light and color. In this imaginary journey we find the impressions, which the lighting and the color of Nature left behind, intermingled with the imprints of usage. Doubtless, many of the latter have vanished. Certainly, some of them are so faint that their existence is scarcely recognized and their origin is a matter of conjecture. Nevertheless, many are still vivid and they must be taken into consideration if we are to understand fully the powers of light and color. In reviewing the past, we find a complex web whose complexity is not only due to the entwining of many customs, but also to a lack of complete knowledge pertaining to the origin of these usages. We may make some errors in our analyses, but inquiry of this kind at least adds to our appreciation of the importance of light and of color and in most cases adds greatly to our knowledge of their significations.

CEREMONIAL USES OF LIGHT

According to the Grecian myth, Prometheus brought fire and all its blessings from heaven to the human race, to whom these benefits had been denied by Zeus. The Greeks not only enthroned fire as of divine origin and made it a phenomenon for worship, but also marked this gift of fire and artificial light as the beginning of civilization. Naturally, this divine origin of fire and light made these "primordial elements" holy. Thus, artificial light represented divine presence and many ceremonial uses of fire, lamps, and candles evolved. This is a natural outgrowth of the more primitive worship of Nature's light sources, and particularly of the sun. The Egyptians and the Assyrians worshipped the sun god long before the Greeks established their more refined customs. In fact, fire and light have played prominent parts in the ceremonies and even in the literature of most religious creeds.

The Bible contains many symbolisms and significations of light. According to the First Book of Moses, the Creator provided light after creating the heavens and the earth. Following the example of other creeds, Christ was proclaimed the true light. Christians became children of light and were to wage war against the evil powers of darkness. The seven-branched candlestick was lighted eternally and it was an accompaniment of worship. The perpetual fire came originally from heaven and was to be kept burning on the altar. Those who were responsible for maintaining these eternal lights were guilty of a very grave offense if these burning candles became extinguished. Naturally, these ideas and customs evolved from those of earlier centuries.

The Greeks and the Romans burned sacred lamps in the temples, in the tombs, and before the statues of gods and heroes. Lamps have been found in wall niches in the catacombs of Rome. Lamps were buried with the dead in early centuries in Asia and the custom extended to other countries. The Jewish synagogues have their eternal lamps. The Brahman maintains a fire on the altar, worships Agni, the god of fire, and makes fire sacrifices. The Mohammedans use lighted lamps in holy places. The torch race originated in a Grecian ceremony of lighting the sacred fire. The celebration of Easter in the Church of the Holy Sepulchre in Jerusalem is accompanied by impressive symbolisms of fire and light. The climax of the ceremony is the descent of the Holy Fire. The great central candelabra becomes ablaze with light. The worshippers light their wax tapers and rush forth. The fire is considered of divine origin and symbolic of resurrection. Naturally, the light sources and the lamps of the period in which any particular custom arose have been associated for centuries afterward with that ceremony. Thus, the use of candles have survived throughout hundreds of years of evolution of light production.

During the first two centuries of the Christian era the ceremonial uses of light were quite limited, but as time passed they became complexly and extensively interwoven into ordinary services as well as those special ones, such as marriages, baptisms, and funerals. In the fifth century the Pope provided a ritual for blessing the candles. The feast of Purification of the Virgin was inaugurated and it became known as Candlemas day, because the candles for the entire year were blessed on this day. However, altar lights were not generally used in the Christian church until the thirteenth century. There were originally seven candles carried by officials of the church and placed near the altar. The wax candle was largely used in the religious ceremonies. In its earlier form it was pointed out that its rush wick developed in pure water, its wax was the product of virgin bees, and the flame was sent from heaven. To the bishop who originated this pretty fancy, the wax candle was appropriate for religious ceremonies. Later, the wax became symbolic of the Blessed Virgin and of the body of Christ. The wick was symbolic of Christ's soul, the flame signified his divine character, and the burning candle became symbolic of his death. Fire and flames are emblematic of fervor and martyrdom. The flaming heart acquired the significance of piety and divine love. The lamp, lantern, and candle are symbolic of piety, heavenly wisdom, and spiritual light.

The rituals of the Roman Catholic church contain many beautiful and impressive symbolisms of light. On Easter eve a new fire or light is kindled, which is emblematic of the arisen Christ. The Paschal candle symbolizes a victorious Christ, and from it all the ceremonial lights are lighted. The latter then becomes emblematic of the presence of Christ. A service traced to the eighth century is that of Holy Week when thirteen lighted candles are placed before the altar and then, as the penitential hymns are sung, extinguished one by one. The last one is left burning and is carried behind the altar. This symbolizes the last days of Christ on earth. The burning candle has assumed the signification of the light of Christ. Lighted candles are placed in the hands of the baptized persons and are carried by persons about to take vows. They are placed around or near the bodies of the dead. In all such cases the light of Christ is symbolized.

These are merely glimpses into an interesting phase of the use of light which is very extensive and far reaching in its results. Many symbolisms and significations have become firmly rooted, so that the early light sources and lighting devices have certain meanings in certain places. In the church, the older light sources have been replaced by electric lamps in many cases, but the meaning still endures. Through ecclesiastical painting, sculpture, and architecture many of these symbolisms have found their way into ornamentation. Certainly, no one can fully understand and utilize the powers of light without having an appreciation of these deeply rooted usages and their origins.[1]

COLOR NAMES

Colors have acquired many attributes and significations throughout countless centuries of extending usage. In studying these, we must follow many byways, but the main highway is backward along the course of civilization toward primitive men and their relations to Nature. From the very beginning of our study we are confronted with the indefiniteness of color names. Even today most educated persons cannot, in many cases, apply a color name which is a fair description of any particular color. Those belonging to lower levels of civilization are less capable of doing so. A general lack of the logical standardization of color terminology spares the public in general from criticism. The languages of highly civilized peoples are rich in the number of color names. In fact, there are too many names. On the other hand, primitive languages have very few. Thus, all civilizations are handicapped, with the result that color names are often confusing, sometimes amusing, and generally unsatisfactory.

The many thousand colors could now be designated consistently by a few fundamental names and symbols having a scientific basis instead of a haphazard multiplicity of more or less meaningless terms. We could begin with standardized names for the pure spectral hues (such as violet, blue, green, yellow, orange, and red) and then designate their tints and shades by numbers. With standardized color charts, we would soon learn to recognize fairly satisfactorily the thousands of colors by their symbols. If we start with a certain pure hue, like orange, we could have ten tints of it and ten shades of each tint. Each tint could be indicated by a number from one to ten and each shade could have its proper number. This theory is introduced merely for the purpose of indicating to the reader an ideal which can be reached.

Most persons are confused in naming colors in the blue-green region. Some will call the color *blue;* others *green.* Few will correctly name the color *blue-green.* Purples also cause much difficulty. In general, any color which has both blue and red in it belongs to the class known as *purple.* Artists commonly name a bluish-purple a *violet* when it is by no means the pure violet of the spectrum. Likewise, a very reddish-purple is usually erroneously termed *red.* Examples of colors which belong to the class known as *purple* are rose magenta, lavender, and mauve. Much will be gained by those who overcome their confusion in these two groups of colors.

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[1] LUCKIESH, M., "Artificial Light—Its Influence on Civilization," The Century Co., 1920.

If we go back to primitive languages, we find some interesting side lights on color names. The languages of primitive tribes have color names, which increase in number with the level of civilization (see Fig. 1). Thus, by examining the languages of various tribes, we obtain a picture of the evolution of color names. Certain very lowly Australian, African, Asiatic, and South American tribes were found to have one name for red, orange, and purple; another for black, blue, and violet; and a third for white, yellow, and green. More advanced tribes had a specific name for red. Next, a name for yellow appears. As the state of civilization advances a name for green is found. One of the last names to appear is blue and among primitive races there is a decided confusion in the blue-green region. Is not our present confusion a lingering remnant of more primitive times—an indication that the evolution of color names or color distinction is not complete?

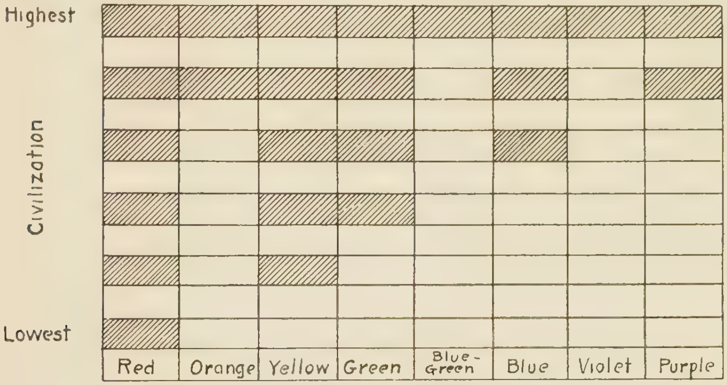

FIG. 1.—The shaded areas indicate the color names found in the languages of races of various civilizations.

Red objects are relatively rare in Nature, from the viewpoint of area occupied. Therefore, they are more novel than the green of great areas of vegetation and the blue of the sky. Furthermore, meat, fruits, iron, and other things useful to the savage are often red. Is it not likely that novelty and necessity had much to do with establishing a name for red in the languages of primitive beings? Certainly, there is abundant proof that color names evolve from the red end toward the blue and violet end of the spectrum.

Some of the American Indian languages have no color names, the color of an object being described as like that of another common object. This is perhaps the earliest kind of color designation. For example, the color of an object is like that of an orange—a case which has come down to us and is a fixed color name in our present vocabulary. We use the term without thinking of the fruit which gave it its name. Perhaps the next stage of evolution is that in which all objects which have about the same color are compared with the standard color, such as orange. In the final stage, abstract names begin to appear. Doubtless, the usage of a color name becomes fixed if the name is employed sufficiently, and this is done if the need for it is quite urgent.

The modern languages of the highly civilized peoples are far richer in abstract names for the colors of the red end of the spectrum, that is, from yellow to red, than for colors in the violet, blue, and green regions. Some color names for reds and yellow and their tints and shades are red, rubicund, russet, roan, auburn, carmine, crimson, scarlet, brown, bay, sorrel, dun, yellow, tawny, sallow, lurid, buff, maroon, vermilion, magenta. Some of these are names of objects which are no longer associated in our minds when we use the color name. Some color names for the other half of the spectrum are green, verdant, blue, azure, livid. One can think of only a relatively few names for the blue region of the spectrum as compared with the names available for the red portion.

It is also interesting to inquire into early writings for a glimpse of the color names of the early civilizations from which we have emerged. In the early Chinese and Semitic writings, in the Indian Vedic Hymns, in the Norse Eddas, and even in early Greek literature names for blue and green are scarce compared with those for yellow and red. The Vedas contain many descriptions of the sky in all its variety of moods, but that the sky is *blue* cannot be gathered from these poems. The sky or heaven also plays a prominent part in the Bible, occurring in the first verse and in at least over four hundred other passages; still the blue color is not mentioned. In the Rigveda Hymns the earth is not mentioned as being green and the sky is not termed blue. Even a name for yellow is absent in many early writings.

The development of the child is considered to be analogous in many respects to the evolution of the race. The child does not distinguish colors until long after it has learned to discriminate many common objects correctly. Certainly, the child, like the savage, is impressed with striking colors before it is with tints and shades. The finer feeling toward colors is a matter of taste and intellect, and these are largely matters of civilization. The symphony of the greenish-silvery grays of a Corot does not appeal to the primitive mind.

The symbolism of color, established from long usage, is an interesting subject. Some of the symbolisms arose quite naturally from experiences with colors as found in Nature. Others became established by a more or less arbitrary, but continued, usage. A wide acquaintance with the symbolic uses of colors is very helpful in understanding and in drawing upon the powers of colors in their many applications.[1] In this book, however, we may peep only into a few of the many byways.

The symbolisms of color arise from any source where color is used more or less appropriately and for a long enough period. Of course, they began with Nature's usage. Many uses became standardized in mythology. For example, divine beings were supposed to inhabit Heaven, which was in the blue-sky region. Naturally, blue became symbolic of much that was associated with divine beings.

The Church has established many symbolisms by using color in its ceremonies and by standardizing the colors of details in ecclesiastical paintings. These symbolisms spread throughout painting and decoration. Certain usages of color become established in literature and particularly in poetry. All these symbolisms that are consistent or appropriate enough to survive do so through their continually extending usages. Even in the everyday activities of civilized people, symbolic uses of color are being established. For example, red is firmly established as a danger signal and when we see a red light at night we are on the lookout for danger. Other standardized color signals, by continued usage, are establishing symbolisms.

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[1] Luckiesh, M., "Light and Color in Advertising and Merchandising," D. Van Nostrand Company, 1923.

In a superficial survey of color symbolisms many seemingly contradictary attributes of color are noted; these disappear, however, on further examination. With this in mind, let us consider briefly a few characteristic symbolisms of the more common colors. It should be understood that various hues, tints, and shades are implied in the terms *red, green, etc.*

Red.—Many symbolic uses of red have arisen from associating this color with blood. For this reason it symbolizes martyrdom, tragedy, anger, danger, war, cruelty, hatred, valor, strength, power, revenge, manhood. Tints of red are usually associated in its gentler offices. Then it represents love, beauty, bashfulness, health. The yellowish- and orange-reds symbolize fire, flames, and heat.

Yellow.—This color and its various tints and shades bordering on orange are warm and luminous. It is symbolic of warmth, light, and the sun. In this sense it is gay and enlivening. Gold is lustrous, rich, brilliant, and glorious. It represents glory, splendor, power, and richness. When it is a greenish shade it is sallow, tawny, citrine. It now is emblematic of sickness, cowardice, indecency, morbidness, sensationalism, jealousy, quarantine, inconstancy. The darker shades of orange-yellow are brown, and these signify strength, solidity, vigor, fruition, harvest, dignity, and, to some extent, sadness.

Green.—From this color of springtime arise such symbolisms as youth, cheerfulness, hope, promise, life, immortality, plenty, faith, resurrection, and memory. Practically all its definite symbolisms are those which associate the spring of life with the spring of the year. Being emblematic of youth, it also symbolizes inexperience, untried manhood, and immature judgment.

Blue.—Much of the symbolism of this color may be traced to the blue sky and its associations, such as heaven and the abode of the gods. Thus, it symbolizes love, intelligence, truth, hope, constancy, fidelity, generosity. Throughout mythology, ecclesiasticism, and modern poetry, blue robes are assigned to appropriate characters. The sky is serene and also harmonizes well with Nature's colors because we are so accustomed to the presence of this color in our landscapes. Therefore, blue has acquired the attributes of serenity and harmony. The sky suggests coolness and even coldness. Shadows are bluish because they are illuminated by sky light. Shadows are often

Nature's solitudes. From these viewpoints, blue is cool, cold, subduing, melancholy, and even depressing. When blue is greenish, it assumes some of the influence of green. When it borders on violet, it becomes subduing or depressing.

Purple.—This color consists of blue and red and, therefore, its attributes modulate from those of violet to those of red, depending on whether it is a bluish-purple or a reddish-purple. Besides these symbolisms it is royal, stately, pompous, rich, and sedate. Tyrian purple was a very costly coloring; therefore, it naturally was used only by the wealthy, including, of course, royalty.

White.—This is such a "clean" color that it is not surprising to find it symbolic of light, purity, chastity, innocence, truth, modesty, peace, piety. It is also natural that it symbolizes femininity, delicacy, and infirmity. By extension of this association, a pale complexion signifies ill health, lack of stamina, and a delicate constitution. Naturally, we have the white flag of surrender, the white feather of timidity, the white shield of untried manhood, and the white emblem of peace.

Black.—This has quite the opposite symbolisms of white. It represents night, darkness, nothingness, and mystery. Naturally, evil spirits and deeds are associated with darkness. Black has become symbolic of woe, gloom, darkness, dread, death, and even terror, horror, wickedness, and crime. When combined with white, either as a gray or as black and white, the symbolisms are humility, melancholy, resolution, solemnity, secrecy and prudence. Night also has another aspect. It awakens the imagination. The starry sky suggests endlessness and profound silence. Black is a powerful color of many possibilities in decoration.

These are just a few glimpses of a very interesting phase of color. Naturally, objects of characteristic color acquired the symbolisms of the colors themselves. For example, the red rose, the white lily, and other flowers have many definite symbolisms appropriate to the colors. It is obvious that associations—isolated mental processes which become related to each other and blended more or less, but not sufficient to lose their identity—are responsible for a great many significations or symbolisms of light and color. A thorough discussion of these would lead us too far afield, but the brief survey presented in the foregoing paragraphs should be useful and should also aid the reader in extending his own analyses. Plenty of material will be found throughout the fields of decoration; of ornamentation, where the torch, the lamp, and other elements are employed; of various ceremonies and rites in the church, in the lodge room, and elsewhere; in the theater; in painting, particularly in ecclesiastical art; and in various other phases of civilization.

CHAPTER IV

THE PHYSICAL BASIS OF LIGHT AND COLOR

It is not the intention to present a detailed discussion of the science of light and color, because this has been adequately treated elsewhere.[1] It is necessary, however, to discuss certain important principles which are not generally understood, and to define certain terms which are very much confused. In fact, the development of the use of color is inhibited to some degree by a widespread inaccuracy of terms and also by the teaching of certain incorrect principles of color. We should be particularly interested in these fundamental principles, because, without a correct understanding of them, the effects of various illuminants on colors and the results of mixtures of colored lights cannot be predicted. If one makes the slight effort necessary to acquire a foundational knowledge of a few underlying principles, however, the whole science of color becomes a much less complex and confused realm.

THE SPECTRUM

There is only one fundamental physical characteristic of light. This is termed *spectral character*. The light from the noonday sun is approximately white; that is, a colorless surface—for example, a so-called white paper—appears white. If we examine this light with a suitable instrument, we find that it consists of radiant energy (electromagnetic energy) of various wavelengths. The prism in a spectroscope separates these radiations of various wavelengths and we see a colored band, which is termed the *spectrum*. Similarly, raindrops produce the rainbow. If we examine this colored band closely, we see four very conspicuous colors—red, yellow, green, and blue. If we wish to subdivide it further, we would next name violet and orange. We could go further and apply other names and combinations of them. In fact, with a suitable instrument it is possible to distinguish about 150 distinctly different hues. However, the six chief spectral colors are violet, blue, green, yellow, orange, and red.

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[1] Luckiesh, M., "Color and Its Applications," D. Van Nostrand Company, 1921.

This classification accounts only for the radiations or electromagnetic waves to which the visual organs respond. The spectrum actually extends far on both sides of the colored band or rainbow which we see. Beyond the violet is a great region of progressively shorter wavelengths known as the *ultra-violet.* Beyond the deepest visible red is a very extensive region known as the *infra-red.* Our present viewpoint is not concerned with these regions beyond, but they are mentioned for the purpose of presenting a familiar analogy.

The visual organs are similar to radio receiving sets and they may be considered to be tuned to receive electromagnetic waves of a certain range of wavelengths which produce certain sensations of color from deep-violet to deep-red. The sun or any primary light source is a sending station. Colored surfaces which reflect light or colored media which transmit light may be considered to be secondary light sources. In fact, we may extend the analogy by considering these to be interfering stations. They intercept some of the visible radiations and thereby modify the light before they emit it again. A perfectly absorbing surface (there is none in reality, but black velvet is nearly so) corresponds to a perfectly interfering station. For transmitted light, an opaque surface corresponds to a perfectly interfering station. Clear glass does not alter the light, but it absorbs some of it. Common white surfaces do not alter the light by reflection, but they absorb from 20 to 30 per cent of the incident light.

WHAT IS COLOR?

Color is not inherent in the object; it is in the light. In fact, it is really the result of radiations of various wavelengths impinging upon the visual organs. For example, a red glass is so constituted chemically that only light waves of a certain range in wavelength are transmitted. The others are absorbed. The effect of these transmitted rays is a sensation of red. The same discussion applies to a red pigment which reflects rays of a restricted range of wavelengths and absorbs the others. Prussian blue appears blue in hue because these rays are predominantly reflected, while most of the radiations of other wavelengths are absorbed, although it reflects blue-green, green, and violet to a considerable degree.

The same explanation applies to illuminants. If a so-called white surface is illuminated by the light from a candle, the surface appears of a warm, yellowish tint. The same effect is produced by a colored glass or gelatine interposed between the noonday sun and the white paper. In the latter case the violet rays are largely absorbed; the blue rays to a lesser degree; the green rays to a still lesser degree, and so on. In other words, the light from a burning candle consists of a superabundance of yellow, orange, and red rays, but relatively insufficient quantities of violet, blue, blue-green, and green rays. This is why it appears a yellowish tint. The white paper appears bluish under light from the blue sky because the light is rich in violet, blue, and blue-green rays relative to those of longer wavelengths. A red light is red because the red rays (and usually some orange and even yellow rays) are predominantly present in the light which reaches the eye.

The effect of various colored lights on the appearance of colors is also easily understood by extending the foregoing discussion. It has been seen that a so-called red pigment appears red because it reflects predominantly the red rays (and usually some rays of neighboring wavelengths) of the light which illuminates it. If the illuminant does not contain any of these rays which the pigment is capable of reflecting, the pigment will appear black. This is practically the case when the light from a mercury arc illuminates the so-called red pigment, because this illuminant is practically devoid of red rays. If a pure blue or green glass is placed before the pigment or before our eyes, the pigment will appear black, or nearly so.

Thus, the spectral character of the primary light which illuminates a colored object and of the secondary light which is reflected or transmitted by the object is the important fundamental. An inexpensive pocket spectroscope reveals these facts very strikingly. In judging a color, it should be noted that the color which is seen is the resultant of all the spectral hues in the light reaching the eyes from the color. The dominant hue may be red, green, or any other, but in all cases objects reflect some rays of other hues. These are synthesized by the eye. The ear is analytical. It is capable of analyzing into its components a chord in music, consisting of various fundamental sound waves of different wavelengths. The eye is not capable of doing this with a group of light waves of different wavelengths. If this

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distinction is not realized, many difficulties arise, as will be seen in later paragraphs.

In general, the purity of colored lights can be much greater than that of pigments and other media which depend for their color on the reflection of light. We must accept a reflecting colored media as we find it, although its purity of color may be enhanced by judiciously mixing the proper color with it. But this results in darker color, that is, a deeper shade. With transmitting media such as are used for obtaining colored light, we are not limited by the amount of light behind the colored media. As we increase the purity of color by making the colored glass denser or of greater spectral purity by combining other coloring elements, we can counteract the decreased transmission by using light sources of greater candlepower. Of course, we can illuminate the reflecting colored media such as pigments to a greater intensity, but this is often impracticable without increasing the brightness of areas which may already be bright enough. Thus, the powers of light are revealed in other aspects.

HUES, TINTS, AND SHADES

There is much confusion in regard to the terms pertaining to brightness and color. It would make little difference what terms were used, provided they were logical, definite, and universally used. The terms discussed herewith are those that have stood the test of time in the science of physics and they have the support of many scientific organizations and scientific men. Various persons interested in light and color will find greater pleasure in discussing and in planning lighting effects, interior decoration, etc., if they have a clear conception of what color is and how its variations can be expressed.

In looking at a group of colors we find that they not only differ in hue but also in brightness. Therefore, we must account for both *hue* and *brightness* in our description. Hue is expressed scientifically by the wavelength in the spectrum which corresponds to it in hue. Hue is expressed in practice by the name of the color, that is, a color may be blue, orange, red, etc. Hue, then, is implied in the color name.

If we mix with a red pigment a small amount of black, we have a light *shade* of red. By mixing more and more black with it we can produce a series of shades of red. It is seen that *shade* pertains only to brightness of a color, because the black does nothing but reduce the brightness, provided it is perfect black. Commercial black pigments reflect a slight amount of light, and therefore are not perfectly black.

We can easily distinguish a difference in brightness of about 2 per cent. Therefore, the number of shades of any color which we can possibly produce depends upon the brightness of the original color. Vermilion is initially a dark color, usually reflecting not more than 20 per cent of the light incident upon it. Therefore, we can easily distinguish only about ten shades of it.

If we begin with white, we can construct a series of grays numbering about forty to fifty, each one being just a trifle darker or lighter than its neighbor. Taking all colors, which vary greatly in initial reflection factor or brightness, an average of about thirty shades for each may be assumed.

Now let us turn to another factor which has not been mentioned. Suppose we start with a pure color, such as vermilion, and add white to it. It becomes brighter and the color is diluted. With shades, the *color is not changed.* By mixing more and more white, we can produce a series of *tints,* with the pure color at one extreme and white at the other. This process does not apply merely to pure colors. We can begin with a shade of a color and start to dilute it with white. We now obtain *tints of this shade of a color.* Taking all colors and shades, we may estimate that we can distinguish an average of about twenty tints for each color.

We can distinguish about 150 different hues quite apart from tints and shades. If each of these, on an average, may be made into 30 shades by adding black, and if each of these shades may be made into an average of 20 tints by adding white, then we can distinguish (150 times 30 times 20) about 90,000 colors, in the broad sense of the term. It is also seen that *shades* are merely decreased brightnesses of the original hue or tint and they refer only to the brightness factor of color; and that tints are actual dilutions of the hue or shade made by the addition of white, that is, brightness replaces some of the hue portion of the color in making a tint. A *tint* of a pure hue or shade is *always brighter* than the original hue or shade. A *shade* of a pure hue or tint is *always darker* than the original hue or tint.

Now let us take up another matter that is almost universally overlooked. Shades are merely the results of reducing the reflection factor or brightness by adding black. This amounts to nothing more than absorbing light. The portion of the shade which is black reflects practically no light; hence, the lower brightness. If we take a number of areas of the *same* color and *illuminate* them to different intensities, we can arrange them in a series of shades. By using light, we are not limited in our series of shades to an average of thirty. We can place at one end of the series a pure hue or tint in darkness. At the other end the same pure hue or tint can be illuminated by a very high intensity of illumination equivalent, say, to direct sunlight. Thus, a very great range of shades for any pure hue or tint results from varying the intensity of illumination. This is what happens to an interior. A portion of the wall painted exactly the same as another portion, but receiving less light than the other, is, as far as appearance is concerned, a shade of the other. If we look around us, we see this demonstrated on every hand.

The interior decorator and others interested in decoration do not recognize the importance of this fact as they should. Decorative schemes are usually planned on the basis that all areas will receive equal illumination. It should be noted that light has a great effect upon color in general; however, by varying the intensity of illumination we chiefly vary *shade*. Tint and hue are only slightly modified in any practicable limits by changes in intensity of illumination.

The foregoing discussion emphasizes in another manner the powers of light which may be utilized if we view light as a medium of expression.

THE PRIMARY COLORS

Much erroneous practice has resulted from confusion in regard to primary colors. Most persons gain their entire knowledge of color from their use of elementary pigments or water colors in school, but these teachings fail when we enter the field of light and lighting. In fact, some misnomers are common in the teaching of color mixture for painting and dyeing. In the first place, what do we mean by primary colors? The answer depends upon the aspect of the use of color in which we are interested. If we ask this question of a person unfamiliar with the use of color, he will choose those colors which are distinctly different. There are only four colors which possess this distinction; namely, red, yellow, green, and blue. Hues of these may be chosen from the spectrum, which are totally unlike, that is, in which no suggestion of another color is to be found. This is not true of blue-green, for example, for in this color we see both blue and green. It is not true of orange, for in this color we see suggestions of yellow and of red. It is not true of so-called canary, for in this yellow we detect green. The foregoing applies only to what is seen by the unaided eye.

Newton gave to the world so much of scientific value that we should not criticize him for naming seven spectral colors—violet, indigo, blue, green, yellow, orange, and red. He could not foresee that persons with a superficial knowledge of color would eventually associate these seven colors with the seven whole notes of the musical octave. In fact, Newton must have recognized more hues and must have considered these seven as the most conspicuous. However, there is not so much necessity for naming indigo as blue-green or orange-red. Furthermore, those who attempt to construct a relationship between these seven colors and the musical octave leave out that group of beautiful colors which may be classed as *purple.* This color does not exist in the spectrum, so that, where color practice for pleasing the eye is involved, the spectrum must fail as a foundation. Finally, it should be obvious that two arts which appeal to us through such different channels as music and color can be related only through their psychological effects.

Through systematic research it was found that the painter could produce a great variety of hues by mixtures of three particular colors. In fact, the variety was great enough so that they served very well for many of the requirements of painting. As a consequence, these three colors became known as primary colors. They were termed red, yellow, and blue. It is true that three colors may be chosen which will produce all the hues desired, although the mixtures will not result in colors as pure as may be desired in many cases. But these three colors are not those represented by the names ordinarily given to them. Actually, they are purple, yellow, and blue-green. In other words, the painter's primary red is not a red, but a purple. Usually, the one chosen is a purplish-red. Likewise, the so-called blue is, in reality, a blue-green. From a mixture of pure red and pure blue, purples cannot be produced. The result of such a mixture would be a dark-gray or a reddish- or bluish-gray. From a mixture of pure yellow and pure blue, green cannot be produced. The result is a gray or a yellowish- or bluish-gray.

These facts of color mixture are readily predicted and explained on the basis of spectral character. Pigments, dyes, glasses, and other colored media are by no means of spectral purity. If such were the case, any two pigments or dyes would produce black, because the result of the mixture is only the color common to the two. For example, a yellow pigment reflects some green rays and prussian blue also reflects some green rays. As a consequence, green light is reflected by a mixture of the two. It is not possible with the unaided eye to appraise with certainty the spectral character of a colored medium; however, it aids considerably to think in terms of the spectrum.

The subtractive principle of color mixture is involved in the mixing of pigments and dyes and in the superposition of colored gelatines and glasses. The best illustration of the results of mixing pigments and dyes is found in superposing colored transparencies. For example, if a blue-green glass is superposed upon a yellow one, the resultant color is usually green. Each of these may be considered to be greatly magnified particles of pigments of corresponding color and, thus, they illustrate the effect of mixtures of pigments. Of course, there are certain surface effects of paints and other reflecting media, but the color is due largely to transmission through various flakes of pigments. The path of a given light ray is deviated haphazardly until finally it is emitted from the surface again after having suffered modification in spectral character. The subtractive method of color mixture is illustrated in Fig. 2. The three circles may be

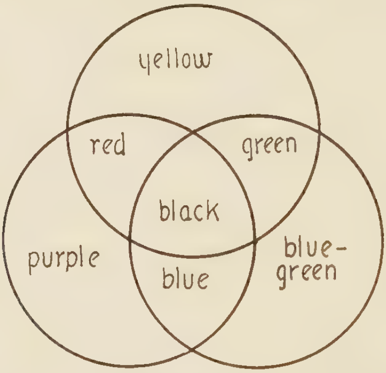

Fig. 2.—Illustrating the results of mixing colors by the subtractive method. The circles may represent overlapping flakes of pigments, pieces of colored glass, or other transparent media.

considered to be three flakes of pigments or three pieces of colored glass overlapping as indicated.

It has been seen that purple, yellow, and blue-green are the primary colors for the special case of mixing pigments, dyes, etc., and that red, yellow, and blue are not strictly the primaries even for this special case of color mixture. There is no sound foundation for considering these to be primary colors in the field of color harmony or general color practice in decoration. Colors in decoration appeal to us by their relative areas, purities, brightnesses, etc. To relate them so that their relationship is appropriate, harmonious, pleasing, stimulating, etc. does not depend upon the fact that three particular pigments or dyes are primaries from the viewpoint of their production of a variety of hues when they are mixed in various proportions. Color practice for visual appeal when built upon such a foundation is not sound. Mixing paints is a physical process, producing certain physical results. The appeal of colors in our surroundings is a psychological process quite unassociated with and unresponsible to the results of mixing paints.

When we study the results of mixing lights, we find another set of primary colors. If we choose the proper red, green, and blue (or violet) colors, we can mix them in such a proportion as to produce any hue we desire. The proper blue borders on spectral violet. These primary colors are perfect ones only when they are of spectral purity. However, transparent colored media, such as glasses and gelatines, can be produced of sufficient spectral purity so that for all practical purposes lights of satisfactory primary colors—red, green, and deep-blue—may be obtained. Many whose knowledge of color is based solely upon painting still persist in choosing red, yellow, and blue lights as primary colors in the production of lighting effects. If we add red light to green light upon a colorless surface, the result is yellow or a neighboring hue, depending upon the proportions of red and green lights. Yellow and blue lights in proper proportion produce white light. This is an additive method of color mixture. The more colored lights we add on a colorless surface the closer does the final result approach to colorless or white light. In the subtractive method, the more colored paints we mix together the closer does the final result approach to black. In practice, the latter final result is really a very dark gray. The additive method is illustrated in Fig. 3, in which the three circles may be considered to be overlapping spots of light of the three colors indicated.

Having correctly determined the primary colors for the subtractive and the additive methods of color mixture, we find a very simple and interesting relationship. Let us add any two of the additive primaries and view the results, which are as follows:

Red + Blue = Purple.
Green + Red = Yellow.
Blue + Green = Blue-green.

We note that the results of the three pairs of additive primaries are, respectively, the subtractive primaries. It will also be noted that the colors of the two sets of primaries are complementary. This relationship, which is illustrated in Fig. 3, is very interesting and a recognition of it simplifies and clarifies the mixture of colors.

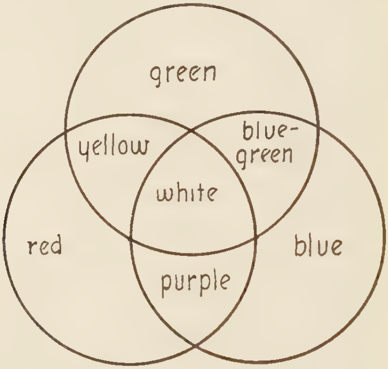

FIG. 3.—Illustrating the result of mixing the primary colors by the additive method. The circles may represent overlapping spots of colored light on a white background.

It may further clarify matters if we begin with the subtractive primaries, as shown in Fig. 2. If we place a yellow glass over a portion of a purple glass, the overlapped portion will appear red. The purple transmits chiefly red and blue. The yellow transmits chiefly green and red. It is seen that only red is transmitted by the two glasses; therefore, only red is transmitted by the two when superposed. We may express the results of the three pairs of subtractive primaries as follows:

Purple − Yellow = Red.
Yellow − Blue-green = Green.
Blue-green − Purple = Blue.

It does not matter which of the pair is on top, because yellow minus purple equals red just as purple minus yellow does. It is seen that the three pairs of the subtractive primaries produce, respectively, the three additive primaries. Aside from some minor effects in practice, the foregoing ideal results are approached in accordance with the proximity of the colors chosen to the actual primaries.

It should be remembered that the eye is not analytical and that we see only a dominant hue in a color which consists of many spectral hues, as is readily proved by viewing the color through a spectroscope. We may have two colors which *appear* identical in hue and even in saturation or purity, but they may differ widely in spectral character. These two colors will not produce the same results in general when mixed with other colors, whether they are lights, pigments, or dyes. The multiplicity of pigments and dyes now available adds some complexity in this respect.

The three additive primary colors—red, green, and blue—are much more generally fundamental than those which are primaries in the mixture of pigments and dyes. Of course, when their correct relationship is recognized, as in the foregoing paragraphs, even the subtractive primaries are indirectly fundamental. The impression we obtain from a color scheme is due to the light reaching the eyes from the various colored areas. The average brightness of a painting, a rug, or a wall covering is the average brightness of the colors weighted according to their respective areas. If color harmonies are to be built on any foundation of primary colors, the more fundamental primaries should be chosen. In color vision, red, green, and blue suffice to produce any hue. In fact, sound color-vision theory has been built on this basis. In some theories, yellow has been included either as a fundamental or as a product of red and green lights. Certainly, psychologically, yellow makes a strong appeal for attention, because it is the only hue besides the additive primaries which can be so chosen as to possess no suggestion of any other hue in it.

It should be noted that in the practice of painting, dyeing, etc. the great multiplicity of coloring media available makes it unnecessary for the artist to depend upon the three primary colors. Furthermore, with this great variety of coloring media a richness in color is obtainable which is impossible from mixtures of the three subtractive primaries. Nevertheless, this great addition to the tools of the painter and decorator does not obviate the necessity for and the value of correct color theory. In the use of lights we may use the subtractive principle for producing the colored media for coloring the light, but in the practice of colored light we must also build upon sound color theory.

COMPLEMENTARY COLORS

It has been seen that each of the additive primary colors is respectively complementary to one of the subtractive primary colors. Thus,

Red is complementary to *blue-green.*
Green is complementary to *purple.*
Blue is complementary to *yellow.*

As has been stated, the blue additive primary is a deep-blue which might be termed violet as well as blue, but the latter term is chosen because it is monosyllabic. Beginning with the accurate and fundamental basis, it is easy to name the other complementaries. Many geometrical areas and solids have been used to illustrate relationships between colors and their tints and shades. All of them fail because the psychophysiological processes involved in vision do not relate colors in this regular manner. Furthermore, unless we specify hues in wavelengths, and also tints and shades in equally formidable numbers, we do not begin with accuracy and, therefore, do not end with accuracy. The author has introduced the color circle with this qualification to prove the necessity for the qualification.

In Fig. 4 the spectral hues are placed in order, from red to violet inclusive, around three-fourths of the circumference of the circle. This is purely an arbitrary circumferential allowance. Likewise, in an arbitrary manner the remaining one-fourth of the circumference is filled with that great family of colors, the purples, beginning at violet with violet-purple and ending at the deep-red with reddish-purple.

The few color names which are shown are merely family names for groups of colors and each family arbitrarily is extended over about one-eighth of the circumference. In this diagrammatic illustration, approximately complementary colors are found at opposite ends of diameters of the circle. It is difficult to represent matters even approximately correctly in such a regular geometrical diagram. In Fig. 4 it is fairly satisfactory if the qualifications are kept in mind. It may appear that yellow opposite violet is inconsistent with what has been stated concerning the primary colors. However, it has been stated that the additive primary blue, which is complementary to the subtractive primary yellow, is really a deep-blue bordering on violet. Furthermore, the actual primary yellow lies somewhat toward orange from the place where yellow is indicated on the diagram. These qualifications suggest the difficulties of simple geometrical arrangement of colors as a basis of color usage. Thus, color practice cannot be based upon geometry any more than upon music. Nevertheless, the geometrical figures aid in visualizing the approximate results. A musical basis is pure buncombe. The remaining portion of Fig. 4 outside the color circle is discussed later.

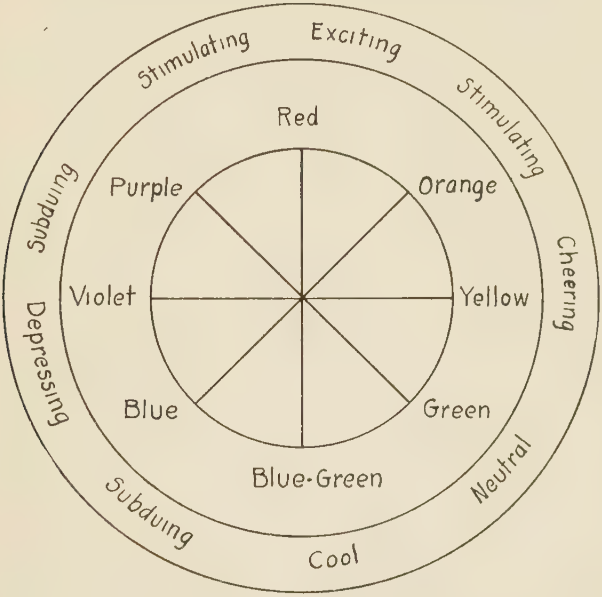

FIG. 4.—The color circle may be presented approximately by the colors of the spectrum from red to violet and the remaining gap filled with the various colors, which may be classified as purple. The psychophysiological effects of the various colors are also indicated.

CHAPTER V

ESTHETICS OF LIGHT AND COLOR

The development of an esthetic sense is a process of observation and experiment aided by certain established fundamental principles and a broad knowledge of many byways. No attempt will be made in this chapter to expound color harmony in the usual manner. This has been done often enough and often badly enough. The object of these chapters is to present discussions not found elsewhere, which will aid in the development of the lighting artist. Some of the foundational material is equally useful to the decorator, the architect, and others in fields aside from lighting. Light as an expressive medium is based upon the fundamentals of painting, sculpture, architecture, and decoration, but with such a primary medium as light we must consider additional facts. Some of the discussions presented herewith are not found in treatises on interior decoration, although they should be. In fact, most discussions of the fine arts and the applied arts do not strike deep enough. It matters not how dogmatically artists and craftsmen believe that they deal with another world of affairs, they cannot know anything with certainty until they have supplied an experimental foundation of physical and psychophysiological facts. We are less certain in the field which we may loosely term *art* than in the field of science, because of a scarcity of systematic analyses and experiment and a looseness of expression. It is the aim here to present some fundamental discussions based upon experimental facts, or at least upon scientific analyses, and to avoid, in so far as possible, presenting the usual discussions of the esthetics of color, which are found in abundance elsewhere.

Too often the artist does not distinguish between *his* likes or dislikes and those of his client or of a certain stratum of people in general. There are certain fundamentals whose influences none of us can escape; however, we should not make the error of assuming that we do not have individual eccentricities of taste. In fact, these secondary differences make us *individuals*. This seems to be perfectly obvious logic; nevertheless, writings and works of the decorator and others on every hand show that this situation is not taken sufficiently into account. Of course, there are many cases where it is quite defensible for the artist to use solely his individualism, but there are many cases where it is indefensible. Certainly, in writings and in teachings, the great fundamentals should not be completely submerged by personal prejudices in details. Certainly, in a home to be occupied by someone else, the architect, the decorator, and other craftsmen should do the work for the clients rather than for themselves.

The treatment of decoration, furnishing, and lighting of an interior should also depend largely upon whether the room is to be occupied by the same persons for long periods, such as a living room in a home, or for short times, such as a dining room. This rule also applies to many other interiors. For example, the foyer of a theater or a hotel is occupied only for brief periods by persons passing through or lounging. Surely, such interiors can be more colorful and more strikingly lighted than a church or a club room. When we see the brilliant red draperies, the checkerboard floor covering, and the variegated upholstery which an interior decorator installs in a living apartment, we wonder if he realizes that he lives with this setting only while producing it. Actually, his clients are to live in it for a long time. We all like to hear a brass band for a reasonable period in the right place, but nobody desires to live with one. On the other hand, the quiet color schemes and restful lighting which are so satisfactory in our living rooms are not necessarily the best for the places where we make merry. The sensible decorator keeps before him the idea of appropriateness. The possibilities of lighting are such that the lighting can be made appropriate for any mood or occasion. Fortunately, lighting is so readily controlled that various effects can be produced in the same room. Gay, sparkling, colorful effects can be made to disappear by the pressure of switches, leaving the room restful and even somber. Herein lies the great future of light as a medium of expression.

EMOTIONAL ASPECTS

The emotional effect upon us is intricately interwoven with our uses of color for decorative purposes. Colors have such physical properties as brightness, richness, delicacy, irregularity, dullness, and purity. When we observe these properties, we are thinking of the colors themselves and their *expressiveness*. However, when we (consciously or unconsciously) analyze ourselves in relation to the effect of color upon us, we are dealing with the *impressiveness* of colors. In this case a color may be agreeable, unpleasant, pleasing, sickening, stimulating, neutral, subduing, depressing, warm, cold, stern, weak, cheerful, etc. Colors affect us in various ways, due primarily to the ages of adaptation to Nature's color scheme during which the human race evolved. As civilization advanced, man standardized certain usages of colors in the artificial world which he has been building. Thus, the effects of colors upon us are due largely to the associations which are aroused when we look at them.

Bright surroundings, such as highly illuminated walls, ceiling, and furnishings, are stimulating. Brilliant effects, such as those produced by crystals, mirrors, metallic paints, silks, and jewels which reflect bright images of light sources, are even more stimulating. Here again lighting is more powerful than the media commonly employed by the decorator. On the other hand, low intensities of illumination produce effects which are subduing. Shadows are restful. Darkness may even be mystifying and awesome. Quite without the use of color we may produce a great range of moods and arouse a range of emotions by means of brightness. Adding to these the powers of colors, we have facilities for much emotional appeal. Colored light is here very powerful, for we may shed it upon everything. Thus, it tinges the entire environment and, thereby, is more powerful in arousing emotions than colored paints, etc.

In analyzing the effects of color, there are four principal aspects to consider. We may logically consider first the objective aspect. From this viewpoint we would note such characteristics of color as purity, delicacy, brightness, brilliance, richness, muddiness, etc. Such peculiarities are the physical properties of the color. Next there is the physiological aspect. With this in mind we would ascertain if a color were agreeable, sickening, pleasing, stimulating, cheering, etc. We might then consider the associative aspects. From this viewpoint we would note the suggestiveness of a color. It would bring to mind various symbolic uses which it has acquired in the artificial world; various associations in Nature; and, doubtless, some individual experiences with it which are not shared generally by others. For example, one woman may not like red because red does not harmonize well with her natural coloring or because she had to wear a certain red dress for a long time through force of circumstances. Such associations, naturally, are the cause of certain psychophysiological effects. In all such analyses we should distinguish between that which is a normal experience of all of us and that which is merely an incident of our own individual lives. Finally, we may consider the character aspect, for colors have character as well as persons. This is the most complex aspect because it is the result of all the properties or powers of a color.

In noting the reactions of various persons toward color, we find that one person may be chiefly concerned with the objective aspect, another with the associative aspect, and so on. It seems that persons who give most prominence to the physiological aspect have the least esthetic sense of color. To them, colors are merely agreeable or disagreeable. Those which are influenced chiefly by the objective aspect seem to rank higher in the scale of development of esthetic sense, because the color impression is of greater importance in these cases. Certainly, those who appreciate the associative aspect of color rank higher than the two foregoing types. Finally, without much doubt, those persons who have a keen sense of the character aspect of colors possess the highest esthetic feeling toward color. These persons plumb the depths of color and are less influenced by personal factors, superficial influences, and irrational associations.

The psychophysiological powers of colors are proportional to their purity. That is, if we dilute a color with white or subdue it with black, the resulting tint or shade is not so powerful in emotional value.

Let us consider the pure colors of the spectrum or rainbow. As indicated in Fig. 4, red, orange, and yellow are exciting or stimulating, scarlet or orange-red producing the maximum effect. Yellow-green, green, blue-green, and greenish-blue are neutral or quieting, green producing the maximum of neutrality. Blue, violet, and purple are subduing or even depressing, violet producing the maximum effect. These effects are obtained for all persons when the colors are viewed just as colors, that is, not as a part of any color scheme. If an entire room and all the objects therein were of the same pure color, the effect upon any normal person would be as indicated in the foregoing. Just as in color preference, the environment of a color or its relation to other colors in a decorative scheme modifies its emotional effect.

Nevertheless, we cannot understand color or utilize its powers without systematically analyzing its various phases.

Although certain emotional powers of colors are fundamentally the same for all of us, our individual experiences are responsible for certain associations which superpose corresponding superficial effects. For this reason colors affect us fundamentally in the same way, but there are minor differences due to individual experiences and racial usages. For example, the Chinese use yellow as a royal or sacred color. We use it as a symbol of light and cheerfulness and also to indicate quarantine, and even associate it with crookedness, such as yellow journalism, or with cowardice. Naturally, our reaction might differ from that of the Chinese. Most colors have acquired some disagreeable attributes, but there are always compensating agreeable ones. Such opposed associations naturally make our usage seemingly complex, but so many factors are involved that usually we can analyze or use colors properly.

A few natural reactions toward color are presented to aid the reader in making his own analyses.

Red may be exciting, loud, passionate, vigorous, manly, bloody, raging. When it is a deep-red, it may be dignified and subduing. When it is yellowish, it may be hot.

Orange is lively, stimulating, warm, glowing, and, therefore, may be comforting or irritating, depending whether or not we desire stimulation or warmth.

Yellow may be joyus, gay, merry, luminous. If it is a greenish-yellow, it may be sickening and suggestive of jealousy and cowardice.

Green may be neutral, peaceful, and perpetual. It is neither sad nor cheerful. As it borders on the yellow, it partakes of the attributes of yellow-green and may be cheerful, smiling, and full of promise. As it borders on blue, it becomes subduing or even depressing.

Blue may be cooling, sobering, subduing. When it borders on violet, it may become depressing.

Violet may be sad, hard, unyielding, as well as gloomy and depressing.

Purple may be impressive, pompous, stately, regal, subduing, depressing, depending upon its proximity to violet or to red.

It may be interesting for the reader to add to these effects from his own experience and to try to analyze the effects of tints and shades of these colors. For example, a tint of red suggests rosy cheeks and, therefore, health and happiness. A complete analysis of this subject here would occupy more space than can be given to the subject.

There are many possibilities in using the emotional value of color in the lighting and decorating of interiors. If we want to get the most emotional value from color, we should use the colors pure and be contrary to Nature and to our everyday usage. In the interiors in which we live and work we can use shades and tints to subdue these powers, but still retain some of the powers. Where we live and work we may desire to be stimulated. Then we can use a warm, stimulating shade. If we desire to be cool and quiet, we can use shades of green, blue-green, or even blue. In color schemes we can use colors of the proper purities and areas which neutralize each other fairly well, but still give us the pleasure of looking at colors. Colored light is particularly effective in making a room feel cooler or warmer than it really is because the light tinges everything. A theater illuminated in the summertime by a light which seems bluish-white will feel cooler than one in which light of the warm flame-tint is used. A room that may appear too "cold" at night may be rendered of the proper warmth of general tone by means of warm yellowish light.

COLOR PREFERENCE

There are many variations of colors and such a variety of combinations of them that no order of preference of colors is apparent. We like all colors in their appropriate places and all colors have their specific uses. However, it is natural to assume that we must prefer some colors, purely for themselves, more than we do others. As in other phases of light and color, systematic researches are bound to yield interesting and useful data pertaining to color preference. In the everyday use of color many factors are involved. If we are to lay a solid foundation for the art of light and of color, we must choose one factor and study it first in isolation and then in connection with the others associated with it in practice. The science of esthetics has much work of this character to do even in the field of color.

Let us first consider color for color's sake alone. In other words, let us see what results have been obtained for various colors considered solely for themselves and not as a part of any color scheme. The manner of experimentation has a great deal to do with the results obtained in such a field as psychology. The data presented here were obtained from 235 college students about equally divided as to sex. Six fairly pure hues (violet, blue, green, yellow, orange, and red), six medium tints of these, and also six medium shades of these were used. Each of these eighteen colors was compared in haphazard order with each of the other seventeen colors and the preferred color of each pair was recorded. Eighteen colors taken two at a time constitute 153 different pairs; therefore, each person had to make 153 judgments. In this investigation 35,955 observations were recorded, each one being made independently, amid neutral-gray surroundings, and as quickly as possible, in order to avoid as far as possible the influence of associations. The observer was asked to choose that color of the pair of colors which he preferred. This procedure was continued for the entire 153 pairs in haphazard order. The results have been confirmed by other investigations, so that they may be considered to be representative of the average absolute color preference of intelligent adult persons. For the sake of distinction, the term *absolute* is used because in this case the preference is based upon color alone without associating it with other colors in a color scheme. In our everyday use of color, this absolute basis does not obtain, for under those conditions many other factors enter which modify our preference. Therefore, we will use the term *relative* to indicate color preference in this complex usage.

Some minor differences were found in the results for males and for females respectively, but, in general, the results were similar. Figure 5 shows the relative number of preferences recorded for each color for the entire group of persons. It is seen that the pure colors (indicated by *P*) are definitely more preferred than tints and shades when colors are considered for color's sake alone, also that the most preferred pure colors are those near the ends of the spectrum, such as red and blue. This is true of tints and also of shades. It is interesting that the absolute color preferences of intelligent civilized adults are similar to those of savages and of infants, who also prefer the pure colors more than tints and shades. This discovery is not surprising, because, when we have eliminated associations as much as possible, we approach the primitive mind, that is, we reduce ourselves to a fundamental being, to which the infant and the savage are closely akin.

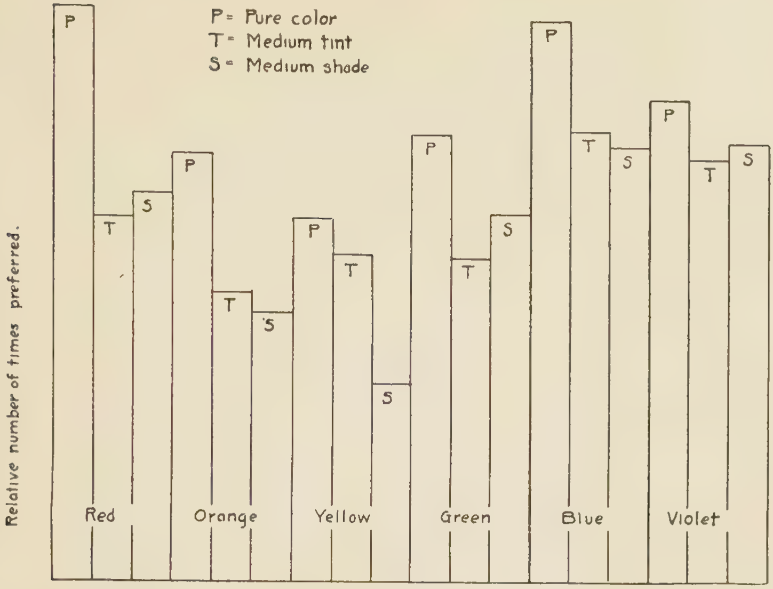

FIG. 5.—Showing the relative number of times various pure colors and their medium tints and medium shades were preferred by comparing two colors at a time of all of the eighteen colors. Obviously, 153 pairs are possible. A preference in each case was recorded.

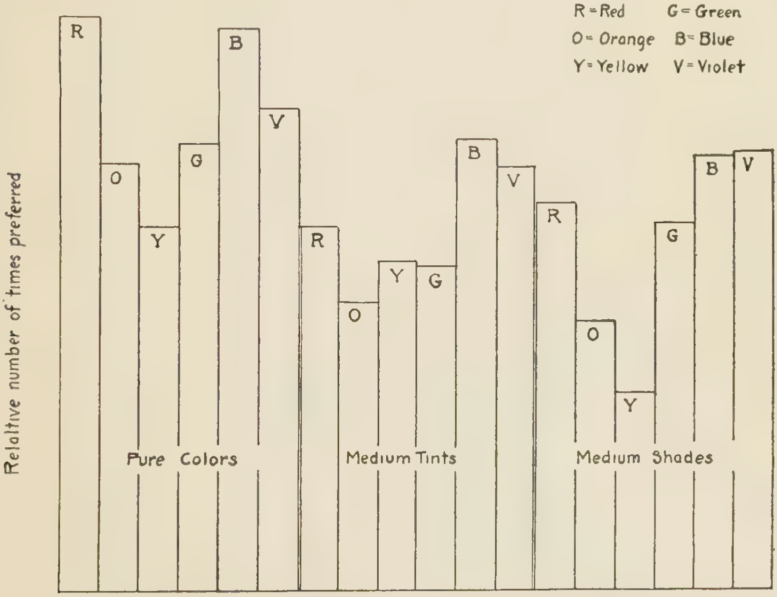

FIG. 6.—Showing the relative number of times that each of six pure colors was preferred. The same comparison is made for the respective medium tints and medium shades of these colors.

In Fig. 6 the results for pure colors, medium tints, and medium shades are separated respectively into groups. Here it is evident that the hues near the middle of the spectrum are less preferred than those nearer the ends of the spectrum.

The total preferences for all the pure hues, tints, and shades respectively are presented separately for males and females in Fig. 7. Here it is seen that both males and females decidedly preferred the pure colors.

Among the pure colors, red and blue were preferred more than the other colors. The males favored blue somewhat more than red, but women favored red slightly more than blue. The order of preference of the pure colors for men was blue, red, violet, green, orange, yellow. The same preference existed for women, except that red was slightly more preferred than blue. No particular stress is placed on this slight difference. Tints ranked generally ahead of shades, particularly for women.

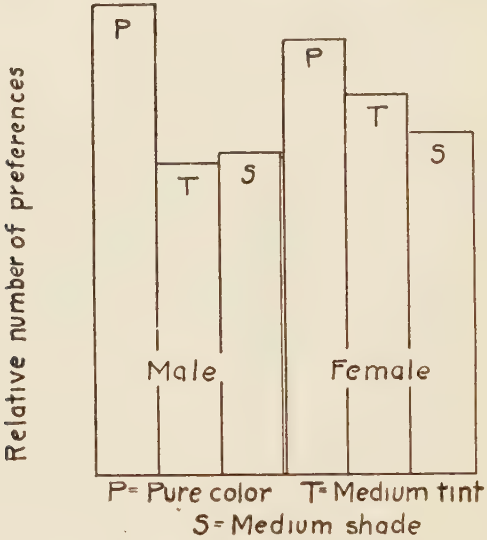

Fig. 7.—Showing the relative number of preferences which a large group of men and women respectively showed for pure colors and their medium tints and medium shades.

Such data are foundational and useful, although it is not safe to consider that this order of preference is invariable. It holds where color alone is of importance and where the color is to be seen in relatively small areas or seen for relatively short periods.

For the sake of convenience, the order of preference for the eighteen colors is given herewith for the males and for the females:

THE ORDER OF PREFERENCE OF COLORS

RANK	MALE	FEMALE
1	Blue	Red
2	Red	Blue
3	Violet	Violet T
4	Green	Violet
5	Blue T	Violet S
6	Orange	Blue T
7	Blue S	Blue S
8	Violet S	Green
9	Red T	Orange
10	Red S	Green S
11	Violet T	Red S
12	Yellow	Yellow T
13	Green S	Green T
14	Orange S	Yellow
15	Green T	Orange T
16	Yellow T	Red T
17	Orange T	Orange S
18	Yellow S	Yellow S

When we investigate the preference for colors for the large areas of interiors, such as walls, which we constantly live with, very different results are obtained. The order of preference is reversed in many respects. Shades and tints of colors are much more preferred for large areas than the pure colors. Usually, a pure color diluted with white to a medium tint and then reduced with black to a shade is a favored color. In other words, colors for appreciable areas must be "grayed" by diluting with gray, in order to be comfortable to live with. In registering these preferences we are showing the influence of the refining process of civilization. When we eliminate from our mind all associations of the color with everyday life, we choose the pure colors and show thereby that the innate appeal of colors is the same for us as for the savage. But when we choose colors to live with, we subdue them. Our finer sensibilities, the result of civilization, are more susceptible to color. To live with an abundance of pure colors is like living with a brass band.

Thus, we have a glimpse of two extremes. How may we profit by this dual color preference? It is a little startling to find that even civilization does not wipe out the appeal of pure colors.

Knowing this, we are encouraged to use more powerful colors where persons do not live or work. Many opportunities for colorful lighting and decoration are to be found in theaters, hotels, restaurants, auditoriums, and even in churches. Even in the dining room of the home, colored lighting has its possibilities without violating any fundamental principles. Where we linger occasionally or for relatively short periods, colorfulness is possible. Introducing this colorfulness by means of lighting has the great advantage of mobility. In other words, the color effects may be brought forth only when desired. When the powers of light are fully recognized, more or less colorless decorative schemes will be colored by light. The architect will direct his genius toward a more perfect use of light. Fixtures, wiring, ornament, and various devices of construction will be so planned that interiors will be painted with light.

HARMONY OF COLOR

Volumes have been written on color harmony. These works contain much valuable information, but usually they err by not beginning deep enough in the subject of color. No one can develop a knowledge of color harmony without a thorough grasp of such foundation stones as color preference, psychological and physiological effects, symbolisms, and all such phases which supply background and feeling for color. Few persons are so devoid of feeling that they cannot develop a sense of color harmony. On every hand one finds many examples of harmony and discord. By observation and consideration of these, a color sense may be developed. There are no simple rules of color harmony which may be applied blindly to any setting unless color is the sole setting. In most places other factors enter in, such as furnishings and usefulness, so that such phases as appropriateness must be taken into account. Then there is the matter of design. We enjoy color independently of design or of association with the object with which it occurs, but usually most of the pleasure which we derive from color depends upon the relations of various colors viewed simultaneously and, therefore, depends upon design to some extent.

In considering a color scheme for a room it is best to settle first certain general underlying questions. Should the decorative scheme be cool or warm? This depends upon the purpose of the room and upon its exposure. Certainly, rooms of northern exposure will be more pleasant, as a rule, if the color scheme gives them warmth. This may not be true in a climate of perpetual heat. Rooms which receive direct sunlight most of the day may have colder color schemes, although this is not an invariable rule. In hot climates this might be desirable, but in cold climates it is likely that other factors would have as much weight. In artificial lighting we do not encounter such questions, because the matter of exposure ceases to be a factor. We may tinge the entire room with any tint we desire. If a room is to be restful, the colors are best subdued to medium shades. If the room is to be one of activity, stimulating colors of lighter shades may be used.

A color harmony should arouse a feeling of completeness. This cannot be if the color scheme is not appropriate for the particular room. Certainly, we may have a correct arrangement of properly related colors and still the color scheme might be inappropriate. Thus, it would be unsatisfactory and incomplete. It would not be a color harmony in this case.

The simplest beginning in the study of color harmony is the construction of a color wheel like that shown in Fig. 4. It will be noted that this is done by placing the pure spectral hues in their natural sequence around three-fourths the circumference of the circle and filling the remaining one-fourth with the purples. Thus, we have a perfect modulation of one color into the other throughout the spectrum and the two ends of the spectrum are connected by a perfect modulation through the purples. We could repeat this for color wheels for any tint or shade. Here we have the complementaries at opposite ends of diameters or spokes of the wheel and also the relationships of colors close together in hue.

There are two fundamental types of color harmony: One consists of complementary colors; the other consists of colors adjacent to each other on the color wheel. For example, we may have a yellow wall with a blue border or *vice versa.* A woman may have a yellow dress with a blue sash or a blue dress with a yellow sash. A man may wear a yellow stickpin in a blue cravat or *vice versa.* The actual purity of the colors used will depend upon their relative areas or their relative areas will depend upon their purities. In general, it may be said that the smaller the area of the color the greater purity it can have with safety. Except for very special cases, which cannot be safely handled by one unskilled in color harmony, large areas should be of subdued colors, such as tints and shades. When colors are pure, a color harmony of the complementary variety, in order to be satisfactory, must consist of colors practically complementary. As the colors are subdued into tints and shades, more leeway is possible.

The other fundamental type of color harmony may be represented by orange and red or by blue and blue-green. An orange wall may have a red border or a blue wall may have a blue-green border. The reverse is also true in each case. Other examples of this type are green and yellow-green and yellow and orange. When the colors are pure, it is necessary that the two hues be quite close together in the spectrum or on the color wheel. As the colors are subdued to tints and shades, the two hues can depart further and further from each other. In this type of harmony a number of different hues can be handled easier than in the complementary type of harmony.

The final appraisal of a color harmony is purely a mental process. No physical device is available for measuring color harmony. At present the complexity which we term a harmonious color scheme contains many factors which have not been laid bare. It has been said that if all the colors of a decorative scheme (when each is properly weighted according to its area) completely neutralize each other, a perfect color harmony has been achieved. In other words, if the various colors were painted on sectors of a disk and the sectors were of the same relative areas as in the decorative scheme, the disk when rapidly rotated should appear gray. This is an example of the many superficialities which have crept into discussions of color harmony. If there are only two colors in the color scheme they must be exactly complementary in order to neutralize each other. Usually, one color occupies so much more area than the other that on a rotating disk of properly weighted sectors they could not possibly neutralize each other. The other type of color harmony which consists of colors closely related in hue could not fulfil the requirement in any instance. The reader unacquainted with the method of adding or neutralizing colors by means of the rotating disk will find this treated in the reference given early in this chapter.

One of the most important relationships concerns purity, brightness, and area of color. Increases in any of these increase the effectiveness of the color. The most powerful effect is produced by means of a pure color of high brightness disposed over a large area. A vase or other ornament may be of a brilliant color without much risk, but great areas should be of more subdued colors—tints and shades—unless the most powerful result of color is desired. At present these relationships must be left to the guidance of taste. Scientific research has not seriously invaded this field. When it does, there is little doubt that the tangled skein of color will be gradually unraveled. However, this will not eliminate the usefulness of the decorator or the necessity for taste. But taste is a dangerous thing unless it is sound taste. Nearly everyone thinks he has good taste; however, few really have it. Through constant observation and a knowledge of fundamental facts nearly everyone may acquire good taste. There is no monopoly which controls it. One is not born with it. Contrary to many statements, it is acquired.

PAINTING WITH LIGHT

All that has been said of color in the preceding paragraphs applies to colored lights as well as to colored objects and to areas done in pigments and similar reflecting media. Some characteristics, however, are possessed solely by light. If an interior is painted entirely in grays, and lights of different tints are confined to certain areas, an effect may be produced which is identical with that which would result from colorless light and colored paints. However, the colored lights are not limited as the paints are. With proper control, a great range of contrasts in brightness is possible. From deep shadow to the brightness of light sources is the range available with primary light.

Light is more effective than the colored media commonly used in a decorative scheme because it tinges everything. The most subtle effects can be produced by light which does not appear colored. For example, light of the quality of that from a candle flame is not appraised as colored light. Its effect is felt rather than seen. Let us illuminate a room with light of an accurate flame-tint and note the warmth which has crept into everything. The room possesses quite a different spirit than when the ordinary light is used. Likewise, a slightly bluer light than ordinary produces a surprising coolness without the color being readily noticeable.

The modeling effects of lighting is also an important factor not only for its influence on various objects, but also owing to the effect of the character of shadows on the appearance of an interior.

A room may be illuminated in the usual manner, but secondary lighting may be superposed. For example, the ceiling and upper walls may be flooded with a low intensity of illumination from concealed sources emitting a blue-green light. Under some conditions this sky effect is charming. When it is not desired, this light may be extinguished instantly by means of a switch. Other colors and tints may be substituted or they may be provided on separate circuits. Niches, panels, ceilings, coves, capitals, plaques, and other architectural details may be painted with lights of the tints desired. Applications of these possibilities are bound to increase rapidly when the possibilities are more widely recognized. With this great property of mobility, light has an advantage over any other medium.

Lighting is a means for introducing sparkling effects into an interior. The esthetics of light include the proper handling of this characteristic of light, so that jewels, gowns, furnishings, etc. in the ballroom, restaurant, and other places where we do not linger long are enlivened. In obtaining this delightful glitter, it should not be accompanied by glaring effects which cause discomfort. Most of the light may be obtained from concealed sources, but a few small sources and crystalline fixtures will produce the desired sparkle.

It is the intention here barely to touch upon the subject of painting with light. This book is largely devoted to this particular subject, so that discussions and suggestions are found in various chapters. It is touched upon briefly in the foregoing paragraphs for the reader who may casually open the book at this chapter.

CHAPTER VI

LIGHTING AND PAINTING

Lighting effects are so intimately interwoven with the physical characteristics of paints and of other materials which are commonly used on the surfaces of interiors that it seems advisable to devote some space to these relationships. After all, paints and other reflecting media owe their appeal fundamentally to light which they reflect as a whole and also from various areas. They must be taken into account in presenting the expressiveness of light. Light on the way from the light source to a surface may be considered to be primary light. When it reaches the surfaces it is partially absorbed. That portion which is reflected is altered more or less in color, and this reflected light may be considered to be secondary light. Lighting effects in a room are due largely and sometimes wholly, to the brightnesses and colors of surroundings, that is, to reflected light. In those cases where the light sources are more or less visible or where the lighting device is more or less vitalized by light, the effect of these primary lights must be taken into account. The entire effect determines very largely the mood or spirit of the interior. In the paragraphs which follow the term *paint* is used for simplicity to mean any medium for covering the walls and ceilings of interiors.

We fail to get the best out of light or of paint unless we recognize their relationship. The brightness of a painted surface depends finally upon light. We may say that one paint is gray and another is white, but obviously both will appear black if they receive no light. The white will appear only as bright as the gray (and, therefore, identical) if it receives only the proper fraction of the amount of light that the gray receives. In other words, the brightness of a painted area depends not only upon the ability of the paint to reflect light, but also upon the amount of light that the area receives. An understanding of these facts is necessary in order to obtain the desired relations of values under artificial lighting.

The color of a paint owes its existence to light as well as to the peculiar characteristic of the particular paint. If we separate light into its components, we find that it consists of lights of various colors, as discussed in Chap. IV. The rainbow is evidence of this, because the raindrops have decomposed sunlight in a very definite manner, and we see it composed of violet, blue, green, yellow, orange, and red rays and various transitional hues.

Artificial illuminants also contain these various colored components, but in different proportions. The result is that colored paints and even grays and white usually appear different under artificial light than under sunlight or sky light.

We are likely to think that a white surface always appears white, but it does not. It appears of the color of the light which falls upon it. If we compare three white paints illuminated respectively by sky light, sunlight, and ordinary artificial light from tungsten lamps, we find that they appear respectively bluish, white, and yellowish. The rainbow or spectral hues in sunlight produce an aggregate effect of white as appraised by the eye. The same hues are found in sky light and artificial light from tungsten lamps, but in different proportions, so that the aggregate visual effect is no longer white, but is bluish-white in sky light and yellowish-white in artificial light.

Now let us consider a colored paint, such as red. This paint has the ability to reflect only the red rays. It absorbs the light rays of other colors. As a consequence, it appears red, because it sifts out all the rays but the red. The others are transformed into heat. This may be proved very simply. If the red paint is illuminated by green or blue light, it appears nearly black. If the red of the paint and the green light are quite pure colors, this experiment is very striking. In any case, it shows that the color of the light has a great deal to do with the appearance of a colored paint.

If one will carefully observe the appearance of colors of a rug, for example, upon which direct sunlight falls, with the appearance of the colors adjacent to this patch which receive only light from the blue sky, the effect of the color of the illuminant will be obvious. The delicate blues and greens will be richer in color under sky light than in sunlight. On the other hand, the reds, yellows, oranges, browns, etc. will appear more vivid in direct sunlight than under sky light. Such an experiment is easily conducted outdoors by casting a shadow on the rug or on any colored surface. The shadow receives light only from the sky, while the remainder of the surface receives both sunlight and sky light. In the latter case the sunlight is predominant, however. In making these observations, due allowance must be given to the greater intensity of sunlight compared with sky light.

Doubtless everyone has noted that an interior appears differently under artificial lighting than in the daytime. Under daylight the colors appear colder than under artificial light. This often works out very well, because the cooler appearance of the interior is quite in keeping with the outdoor landscape which is visible through the windows in the daytime. At night, when darkness has shut out these views, the warmer appearance of the interior under the yellowish artificial light is quite in keeping with the spirit of warmth, comfort, and protection associated with the home and various other interiors. This warmth of color can be carried as far as desired by tinted shades on lamps or by tinted lamps, particularly those of a flame-tint.

Now let us glimpse for a moment the effect of paint and also of lighting on the mood or expression of a room. The decorator in applying paints of certain tints and shades to various areas of the room produces a certain mood. That is the primary object of a decorative scheme, from an esthetic viewpoint. In so far as the decorator is concerned, the expression of the room is now fixed by brightnesses and tints of the various areas. But when we introduce artificial lighting we find that the expression is not fixed. We can direct as much light upward to the ceiling as we desire. We can make it much brighter than the walls or we can leave it relatively dark by favoring the walls, table, and other objects in the lower part of the room. Various lighting fixtures distribute the light differently, with the result that each lighting gives the room a different expression. Add to this the great powers of tinted light obtained by tinted shades or lamps and we have a great range of possibilities of lighting with the *same* decorative scheme. Painting tends to fix a decorative scheme, but lighting can alter this very much. By realizing this relationship we are able to get the most out of these powerful and essential media.

THE LIGHTING VALUE OF PAINT

The ability of surfaces to reflect light is a very important factor in lighting. It is not only important from the viewpoint of efficient lighting, but also from the viewpoints of satisfactory vision and cheerfulness of surroundings. In interiors, paint or any other medium for walls, ceiling, and woodwork would be of little value without light. Its efficiency as a diffuser and reflector of light and its charm as a decorative medium are of no interest unless considered in connection with lighting. These points are seemingly obvious, but they are mentioned because there is a very general lack of clearness in regard to them.

Let us consider the influence of paint on the efficiency of lighting. A light source, such as a tungsten-filament lamp, produces a certain amount of light for a unit of electrical energy. By no means does all this light become useful in the narrow sense. That is, not all this light reaches the work we may be doing or the book we may be reading. It is well that it does not, because, if it did, we would have very undesirable conditions. If no light reached the ceiling, walls, and other portions of the room, we would have a dark, depressing interior. However, we should achieve the proper result without more waste than necessary.

A light source emits *raw* light which, like any raw material, is enhanced in value if it is modified so as better to accomplish its purpose. Usually, bare light sources are glaring and contribute a harshness to the interior. They are harmful to the eyes and they violate the best principles underlying quiet, restful, and comfortable surroundings. Therefore, they annoy our esthetic sense. For this reason, lighting equipment is necessary for directing and diffusing the light and for shading the light sources from our eyes. These shades, consisting of parchment, textiles, or glass, are often tinted in order that we may enjoy the charm of tinted light. By this treatment a slight amount of *raw* light is lost, but that which remains is greatly increased in value.

In diffusing the light some of it reaches the walls and ceiling, so that the reflection factor of those surfaces is important. Sometimes we adopt a system of lighting in which much of the light is deliberately directed to the ceiling, where it is diffusely reflected over the room. Now the reflection factor of the ceiling is very important. If that area is dirty or of a low reflection factor, a great deal of the light which falls upon it is absorbed and lost. Owing to neglect in cleaning or refinishing the ceilings and walls, millions of dollars are wasted each year in paying for light which is lost by unnecessary absorption. Efficiency, in the narrow sense, is not very important in the interiors with which this book is concerned; nevertheless, absorption of light when it performs no desirable function, such as making the lighting or the appearance of the room more satisfactory, cannot be justified. In factories,[1] so-called white paint is quite proper, but in most other interiors, where the esthetic aspect becomes important, it is better to modify the white for ceilings to something like a cream tint. There is only a slightly greater absorption than in the case of so-called white, and the general result is more satisfactory from an artistic viewpoint. Of course, in many cases the color of the ceiling is determined by the desirability of a certain color scheme, but seldom is white necessary.

Walls also may play quite a part in lighting, but the magnitude of their influence depends upon the character of the lighting system. For example, a direct-lighting fixture, such as a dome over the dining table in a residence, sends most of the light downward to the table. Only a little light is emitted toward the ceiling and walls. Some light is reflected upward about the room from the white dishes and the tablecloth. This is quite a proper lighting effect for the dining room and the efficiency of the lighting is not appreciably affected by the walls and the ceiling. Nevertheless, in painting the walls for such a lighting system, it should be noted that the walls are to receive a relatively small amount of light and, therefore, should be painted a lighter shade than would be done if only the daylight conditions are considered. This fact emphasizes the importance of considering the decorative scheme in relation to the character of the artificial lighting.

If a semi-indirect or indirect-lighting system is considered advisable in a certain interior, it should be realized that the ceiling and walls are now to receive considerable light. Their reflection factors are now of importance from the viewpoint of efficient lighting and of the final appearance of the room.

The foregoing discussions emphasize the desirability of surfaces that reflect as much light as is compatible with the proper appearance of the interior. There is little excuse for the use of very dark shades on walls and ceiling. They are depressing; they do not radiate the cheer that they would if painted in lighter shades. In the rooms we live in, dark shades for upper walls and ceiling are seldom justifiable. A satisfactory decorative scheme usually requires walls darker than the ceiling, but they should not be too dark. Of course, fidelity in period style makes certain demands, but why should we become slaves to any period style

[1] Luckiesh, M., "Light and Work," D. Van Nostrand Company.

which makes undue demands upon us to suffer depression and even visual discomfort in this age of adequate light?

Lighting equipment which diffuses light satisfactorily, such as a fixture with proper shades, is likely to be glaring when viewed against dark walls or ceiling. Wall brackets are often found on dark walls, which not only absorb much light, but also produce a glaring condition of lighting. Common sense should forestall the adoption of decorative schemes which are incompatible with comfort.

Efficiency in lighting has been emphasized, but it has been pointed out that efficiency, in a narrow sense, is not the best aim in lighting. We do not want to lose light when there is no gain in better effect, but usually a modification of raw light, or an absorption of it if not carried too far, results in a better effect in a room. We should not live in a room with white walls and ceiling just to save light, but, on the other hand, we do not want walls and ceiling too dark. We should desire cheerfulness in interiors, and this is best obtained by considering painting and lighting together. Each interior, with its specific lighting system, requires individual consideration in this respect. Let us paint walls, ceiling, and woodwork for satisfactoriness in the broadest sense.

PAINTING FOR EYE COMFORT

Probably, 90 per cent of our experiences and our usefulness depends upon the doorway of vision, and it behooves us not only to conserve our eyesight, but also to provide proper conditions for vision. We should not only consider adequate light, but also proper lighting. The latter involves the brightness, and to some extent the color, of backgrounds which in interiors are usually the ceiling and the walls. If we are to view intelligently the problems of lighting and of vision, we must first consider the outdoor conditions under which the human race developed, as has been done in previous chapters. Our eyes are best adapted to daylight quality and intensity. One of the chief criticisms that can be directed toward the use of artificial light is that for serious visual work we do not use enough light. Another is that we use the light improperly.

Outdoors, the sun is so very bright that we cannot look at it without experiencing great discomfort and even pain. Our artificial light sources are not as bright and, therefore, many persons are inclined to be careless. They sit or read or work with bare light sources glaring before them. Outdoors, the sky is a secondary light source of low brightness which can be looked at without suffering discomfort. It is quite harmless in this respect. It sends light into the shadows, not only enabling us to see in the shadows, but it renders the sharp shadows due to the sun much less harsh, and therefore more pleasing. In our homes we can reproduce the sky by painting the ceiling. The walls are painted somewhat darker, quite in keeping with the general plan outdoors. In the foreground (floor) we have the generally darkest areas in a landscape. The middle distance (walls) is usually somewhat brighter, owing to atmospheric haze, etc. The upper part of a landscape is the brightest area. This area of sky corresponds to the ceiling, which sometimes includes the frieze. Any interior which does not conform to this, in general, is unnatural. Certainly, we will agree that a bright ceiling, darker walls, and perhaps slightly darker floor is quite natural. A proof of this is that it has been generally adopted as most satisfactory. This is the first broad principle of painting for eye comfort.

Indoors, where we supply so much less light than our eyes have been and are used to outdoors, we should be careful to do the best we can with paint and light. A ceiling nearly white can contribute very much or very little light to the shadows, depending upon how much light reaches it. If freshly painted with a good paint nearly white, it will reflect about 75 per cent of the light reaching it. If dirty or of a dark color, very much less light will be reflected. This bright area aids vision very much. Our eyes operate better when adapted to these brightnesses than when adapted to darker surfaces. It is very trying on the eyes to look from a white page of reading matter, for example, into a dark field. The eyes need rest and this is obtained by looking from the work or white page to areas only moderately darker. When the eyes must continually adapt themselves to extremes in brightness, they tire quite rapidly.

One of the most annoying conditions is excessive contrast in brightness. The nearly white ceiling aids greatly in eliminating the annoyance of lighting fixtures. Even proper diffusing shades that are comfortable to look at against a bright ceiling will be glaring against a dark ceiling. This is also true of wall brackets against bright and dark walls respectively. Proof of this is easily obtained. At night outdoors, amid dark surroundings, even a candle flame is glaring, but in the daytime it may be looked at with perfect comfort. Outdoors, the sky is harmless and we may look at it without discomfort, but indoors a patch of sky seen through a window amid relatively dark walls is usually quite glaring.

The best insurance against glaring lighting conditions consists of surroundings having moderate or reasonably moderate reflection factors. Here judgment must enter, because in many interiors there are other important elements to consider. We must make a compromise in order to harmonize these elements to the best advantage. Some of these elements are conflicting, so that one might well adopt the slogan "compromise and harmonize." The chief trouble is that often certain elements are not considered at all.

For the reduction of glare, backgrounds should be bright. The ceiling gives us no trouble in this respect. The walls must be of the order of a middle value to satisfy our desire for a natural brightness distribution and to provide some relief or restfulness for the eyes. We must compromise in this case and cannot provide a background as bright as the ceiling, even if we have light sources in wall brackets.

Color, as we use it on walls, ceiling, floor, and floor coverings, plays little part in eye comfort, except as it affects the reflection factor of a surface. In fact, color is a matter more of a psychological nature than of eye comfort. From whatever angle we view the matter of light, vision, and eye comfort, we see that our surroundings are important. Therefore, painting and other surface treatments are real factors in eye comfort and should be considered in relation to lighting as well as to decoration.

DULL OR GLOSSY SURFACES

Where painted surfaces must be washed often, very glossy surfaces render the task of washing easier, but there are so many objections to glossy surfaces that the matter should be carefully weighed. Certainly, glossy surfaces are not desirable in the rooms in which we live, or in interiors intended to possess a dignified charm. The softer effects of dull or semi-matte surfaces are much more appealing to the artistic sense than glossy ones. Paint and its close relatives are superior to other media for the walls, ceiling, and woodwork in the extreme variety of effects obtainable.

Many people have the erroneous opinion that a glossy paint reflects more light than a dull one. This is not true. Even an ordinary silvered mirror reflects only about the same amount of light as the best white paint of dull surface. Dull and glossy surfaces merely reflect light differently, and this difference is very important in most interiors. The dull surface reflects light in all directions; the mirror only in one direction. A paint with a glossy surface is similar to a dull surface upon which a mirror surface is superposed. It is a principle of good lighting to shade all light sources, except in certain large interiors. No matter how well the lighting of a room is done, it is obvious that, if the surfaces, such as walls, ceiling, table tops, etc., were covered with mirrors, the good intentions in lighting will be defeated, because images of the light sources would be reflected into the eyes.

If light sources are concealed in a bowl suspended from the ceiling, they will not be seen directly, but their images would be seen if the ceiling were a mirror. The same is true of the top of a table or of a desk, for, even though we may not see the light sources directly as we sit at a table or desk, we could see these images if we covered the surface with a mirror.

Glossy paints act as imperfect mirrors and reflect the glaring images of light sources into the field of view. This is made clear by a simple experiment. Place a sheet of ordinary glass over a piece of white blotting paper. Now we see the image of the light source reflected from the glass surfaces and diffused light reflected from the blotting paper. Replace the white blotting paper by a dark one, such as a green one. Now the image of the light source reflected by the glass is even more annoying, because it is viewed against a darker background. These are very good models of glossy paints. The experiment teaches us that glossy surfaces are undesirable from the standpoint of eye comfort and that the darker glossy surfaces are worse than the lighter ones. If we value eye comfort, we will avoid such glossy surfaces wherever possible.

There is another important viewpoint—the artistic one. Glossy surfaces produce high lights, haphazard and garish. These are not a characteristic of artistic surroundings, except in those interiors where glitter is specifically necessary. Restfulness should be a keynote of the rooms in which we linger. Here the soft effects of dull finishes are very fitting. Depth, texture, and variety may be obtained by various means. These characteristics of paint are very appealing to the person of good taste and refinement who seeks to make a home comfortable, restful, and a haven of happiness.

There may be some places where the extreme ease of washing glossy surfaces makes them desirable, but even in these places the foregoing advantages must be outweighed by the importance of easy washing before glossy surfaces are acceptable. In interiors where washability may be of some moment, certain dull and semimatte paints have been found to be practicable.

IMPORTANCE OF ENVIRONMENT

Years ago when Darwin enunciated the theory of evolution, which aroused bitter controversies that are still rumbling, he did not expound anything radically new to thinking men. His lifelong study of living things provided the strength of a mass of observations and the clarity of years of thought to a principle which theretofore had been more or less hazy and indefinite, but which, nevertheless, was not strictly new. Certainly, thinking and observing men for centuries had recognized the powerful influence of environment. Darwin gave to the world vast generalizations based upon an imaginary view of innumerable generations of life. It required a great imagination to enunciate the law of the survival of the fittest and great powers of observation and analysis to give this law the foundation necessary to insure it against the attacks which have been directed toward it.

These paragraphs are not a defense of Darwin's theory, for it needs no defense. They aim merely to emphasize the influence of environment in regard to the development of the mental attitude of human beings, and particularly of school children, just as Darwin used it to formulate vaster generalizations. Regardless of our acceptance in full of Darwin's philosophy and theory, we cannot avoid the conclusion that environment is a powerful influence in the physical and mental development of human beings. We know that fresh air, exercise, and good lighting do much in aiding Nature to develop healthy children. We know that teaching expands the mental capacity and that the acquirement of knowledge molds to a certain degree the child's attitude toward his associates and his duties. We believe, to some degree at least, that these things guarantee, in general, a better manhood and womanhood. In other words, we believe that our schools. are influencing the child's development in such a manner as to make a better adult citizenship. In general, this cannot be denied.

Assuming that we are providing properly for physical development and that we are teaching abstract subjects, are we doing enough to mold the child's *attitude* to insure a proper one toward life when it becomes adult? An appreciation of beauty or, more broadly, a developed esthetic sense is a powerful factor in molding good citizens. An esthetic sense cannot be grafted on the child by any simple process. It cannot be fully developed by a few hours with colored pencils. It can be fully developed only by continually fanning the spark of artistic appreciation with which every normal individual is born. In fanning this spark, the environment—the surroundings in home and school—is one of the most powerful and inexpensive allies. Too often it is taken for granted that esthetic sense is a matter of heredity. The science of psychology is revealing a great many facts about human beings. It still concedes much to heredity, but it has shattered to some extent this bulwark behind which the weak and the unsuccessful have been wont to hide. It has shown that a human being has the capacity to acquire much after he is born. In other words, the science of psychology is proving the great importance of environment in developing the child. Instinct is becoming a less inclusive term. Learning and similar influences are being credited with more and more at the expense of instinct and heredity.

It is not the purpose here to provide statistics of crime and of criminals to show that viciousness and well-developed esthetic sense are enemies or even strangers. Doubtless, such statistics are not available, but, fortunately, they do not seem necessary. We do know that vicious men are bred generally amid crude inartistic surroundings, both material and spiritual. We know various facts of a similar nature which make it reasonable to deduce that simple, quiet, artistic surroundings make a permanent impression through years of adaptation to it. Certainly, as we develop a finer sensibility toward beauty or a well-defined esthetic sense, viciousness to the same degree must disappear.

In order to avoid burdening the reader with the results of psychological research and with the philosophies of esthetics, let us suggest that he turn his attention to some of his own observations. As his own esthetic sense developed, he doubtless found it less easy to do some of the things which he did as a child. Doubtless, he can recall this evolution in members of his family and in other associates. The finer sensibility shudders at the little cruelties of the more primitive years of youth. It does not associate with viciousness. It has made a better person and citizen.

It is not the intention to recommend a course in esthetics in the various grades. Such a course perhaps could not be continuous throughout school life, and continuity is necessary for esthetic development. It is recommended, however, that esthetic influences be ever-present throughout the entire life of our children in home and in school. This influence can be radiated by the environment. Homes, churches, school buildings, and grounds should be expressive of good taste. They need not be elaborate, ornate, or gorgeous, for simplicity is more productive of artistic charm. Good taste is often not as costly as bad taste. Many of our new school buildings are a credit to the taste of the architect. Most of our older school buildings are not, for depreciation and repairs have wrought their havoc. Improper lighting is a common evil. The indifference of authorities in regard to the environment of the child is often found in our city schools and very generally in the country schools.

A single-room brick schoolhouse a few miles from where the writer sits is a glaring example of an abortive attempt on the part of the school directors to build an artistic schoolhouse. Instead of conserving their meager funds by providing a simple exterior, an overwhelming front, including a highly ornate dormer, was placed on the building. This front is ugly and entirely out of keeping with the small building, which is otherwise modest in appearance. Nevertheless, the misguided taste which expressed itself in an ugly overwhelming mass was costly, for the ornateness represented an appreciable part of the cost of the building. If this expenditure had been tastefully applied to the interior, everything desirable in finish, furnishings, and lighting could have been had.

Too often in modern buildings the woodwork is stained a very dark color. This doubtless arises from a desire to keep maintenance costs as low as possible. The effect is often depressing and, therefore, inartistic and undesirable. There are lighter finishes which are easily maintained and which are more cheerful and of better taste. The great expanse of walls and ceilings makes these areas of importance in the effect of the interior on the child. Light ceilings, such as white or cream tints, are desirable from the standpoint of lighting and of the general cheerful expression of the interior. Walls are sometimes too conspicuous in color to be artistic and quieting as they should be. Prominent greens, yellows, and blues are often found and sometimes the discord is made complete by using a maroon for the lower part of the wall. The choice of colors for interiors can be founded on definite available knowledge pertaining to the psychological influences of color, but, inasmuch as only subdued colors can be successfully defended for the schoolroom, this discussion need not go deeply into the impressiveness of colors.

Greens and buffs and the light-blue of the sky are Nature's predominant colors of great area during the seasons when we are out of doors a great deal. Centuries of adaptation have made these colors restful to human beings. Certainly red, brilliant yellow, and orange and, in fact, brilliant colors in general are not found in great areas in landscapes. The yellows are subdued into buffs and browns; the greens are subdued into shades; and the blue of the sky is washed out to a tint. We must follow Nature if we are to provide the colors to which human beings are best adapted. Therefore, walls may be of buff and shades of green. The blue of Nature is the sky and hence is somewhat out of place on the lower walls. It cannot be on the ceiling if we are to have good lighting effects. Therefore, it is ruled out of the schoolroom by expediency. This leaves us with greens and buffs for our walls. Both are restful. If there is any choice at all, the buffs which are "warmer" in color may be used in north rooms, to temper to some degree the "coldness" of north-sky light. Shades of green may be used in the south rooms to "cool" the "warmer" direct sunlight. A safe rule is to begin with a light gray and add the color; in other words, to use very subdued colors for walls.

The choice of the colors used must finally be a result of a compromise of all the conditions and aspects of the situation. The ceilings should be white or nearly so for several reasons. A light cream tint is quite generally satisfactory. If the rooms have particularly high ceilings, the ceiling color may be continued down the wall for some distance. This frieze of the same color as the ceiling will do much toward producing an apparent better proportion of dimensions and will also aid the lighting. The color of the side wall should be "grayed," but the hue should lie in midspectrum from green to yellow. If there are great areas of woodwork on the walls, some of this, depending on the pattern, could be of the lighter shade of the wall. If desired, the lower walls can be of a darker color than the middle or upper walls. In many cases painted woodwork is better than stained, although satisfactory stains of moderately light color are available. The wood trimming may be somewhat darker than the walls with good effect. The color scheme can be varied slightly from grade to grade or from north to south rooms. This adds an element of variety which is always pleasing. The walls should be backgrounds against which to decorate with furniture and pictures. They should not be considered "decorations" in themselves. The woodwork, walls, and ceiling should approach artistic simplicity in so far as possible.

From the viewpoint of vision, lighting and the proper use of the eyes are very important for all of us, and particularly for children, whose visual organs are immature in growth and in function. The eyesight of children can be seriously impaired under inadequate and improper lighting. Many investigations have shown that the percentage of children having defective eyes is greater in the higher grades than in the lower ones. This indicates conditions which are harmful to vision. Certain records indicate that, where careful attention has been given to lighting and other visual conditions, a notable decrease in the percentage of defective vision has resulted. This is a phase which is not as far afield from the development of the esthetic sense as it seems to be. Surroundings which are glaring or gloomy are not, by any stretch of the imagination, artistic.

School authorities and architects have under their control various subtle influences which can do much toward developing the esthetic sense of our children. As a nation, we are lagging in esthetic taste. We have a right to be equal to any nation in this respect. Esthetic sense equips an individual to get more out of life's sojourn. But, what is more important, it should suppress viciousness and make for better citizenship. The environment of our schools, extending over about a dozen of the most impressionable years of the life of our children, can by its continuous and subtle influence do much toward making life a better, happier, and more interesting sojourn than it might otherwise be.

CHAPTER VII

PRINCIPLES OF LIGHTING EQUIPMENT

Lighting fixtures are a means to an end and the end is lighting effect. The fixtures are primarily the devices containing the light sources, and their most important functions are to control light. When they are visible, their appearance becomes important, but, unfortunately, decorative fixtures have been given little attention as lighting devices. Such fixtures are too often ornaments, more or less faithfully copied from candelabra and other lighting fixtures of bygone centuries. They are supposed to be adapted to modern light sources when they have been equipped with sockets. But to substitute sockets for the candles and oil flames by no means does justice to the possibilities of modern light sources. Recent advances in electric-filament lamps have introduced the possibilities of light control undreamed of throughout the ages of feeble open flames. Now the light source is safely enclosed in glass. The filaments are concentrated, so that scientific reflectors and lenses are optically effective. Powerful light sources occupy small volumes. Colored accessories are available and colored lights of any desired tint or purity are obtainable in adequate quantities. Electric wiring and switches provide the advantages of remote control. All these developments have increased the potentiality of lighting far beyond the conception of persons who are still thinking of lighting fixtures as merely ornaments of earlier periods equipped with sockets and wired for electricity.

It is true that the oil lamps of Greece and of Rome, the ceremonial lamps and candelabra of the church, the bespangled chandeliers of the Renaissance, and all the gems of ornament of the past will never lose their charm and associations. These we want to retain. However, just as architecture and other phases of human activity undergo changes which better adapt them to later requirements and possibilities, lighting fixtures should change accordingly. No development pertaining to interiors and their equipment has been so sudden and so extensive in its possibilities as artificial lighting. But this has been so recent and so sudden that we are not prepared to utilize modern artificial light to its fullest possibilities.

Then, a narrow slavishness to purity in art also exists. Fidelity to period style is commendable only so long as it is not unreasonable. Change is inevitable in the face of scientific and engineering progress. It is as indefensible to cling to unshaded candles in a modern reproduction of an early English residence as it is to build such a structure without modern heating and plumbing. A compromise is grudgingly made by equipping the candle fixtures with sockets and unshaded electric lamps. Why not cover the lamps with shades, thereby protecting the eyes from glowing filaments, which are thousands of times brighter than the original candle flame, and also concealing the modern lamp so that the illusion is fairly satisfying? But why stop at this point? Why not utilize some of the possibilities of modern lighting? Are we to forego the charm of variety which lighting can afford? Certainly, the architect and the decorator must adapt these new possibilities, just as other advances have been admitted to interiors. The suggestions pertaining to lighting fixtures which are presented in this and other chapters are based on the premise that modern light is a medium of expression of very great potentiality compared with artificial light of all the centuries preceding the present one. It is the hope that these suggestions may aid in rescuing fixture-design from the realm of archeology. Archeologists have given us much in art-forms, but they cannot supply us with lighting fixtures which utilize the possibilities of modern artificial light.

The lighting fixture, if it is visible, can add a powerful note to the lighting effect, but at best it is only a note in the entire melody. It may be a vitalized ornament and as such may be a very important object in the room, but at best it is only an object in the entire setting. It may glow with warmth or color. It may sparkle as a jewel. It may lend its glitter to the jewels, gowns, and other things capable of glittering. It may be a masterpiece of form and color and impressive in size, but it is only an element in an ensemble. After all, the walls, ceiling, decoration, and furnishing constitute the interior and the distribution, direction, diffusion, and color of the light do much in coloring, in shading, and in modeling. The lighting effect plays a great part in producing the mood or expression of the interior. The lighting fixture remains a more or less vitalized ornament.

The arts which are represented in the expressiveness of interiors are arts of light, shade, and color. Forms are modeled by shadows. The sculptor executes an architectural ornament by providing projections and hollows which light models in light and shade. The distribution of light upon the ornament determines the direction and character of the shadows and, therefore, its expressiveness. The painter produces a masterpiece, but the quality of light determines the appearance of the colors. The decorator distributes certain values over the various areas, but these remain fixed only for one distribution of light. When the distribution of light is altered, the values are altered. Thus, lighting paints, models, and decorates an interior to a great extent. Modern light sources may be safely concealed in many places. They may be confined in coves, so that certain panels, friezes, niches, etc. may be made as bright as desired relative to other areas. Glass panels in ceilings or walls may be artificially illuminated from behind. Ceiling fixtures, wall brackets, and pedestal lamps may control light so that it falls upon certain areas, such as paintings, the dining table, etc. Thus, by control of light from concealed devices and from visible ones, we may combine utilitarian lighting, decorative lighting, and esthetic or psychological effects upon the interior as a whole.

SYSTEMS OF LIGHTING

The possibilities of lighting have become so manifold that it is difficult to classify lighting into various systems. Fundamentally, there are only two systems of lighting, namely, direct and indirect.

A system of direct lighting is one in which most of the light reaches the lower portion of the room directly from visible lighting fixtures. Bare light sources amid dark surroundings are commonly assumed to constitute direct lighting. This is also true of the same sources amid surroundings of high reflection factor. If we equip these light sources with pendant shades or envelopes of diffusing media, the system is still termed direct lighting. Obviously, the lighting effects may vary greatly and still be classified in the same system.

A system of indirect lighting is one in which all or most of the light reaches the lower portion of an interior indirectly; that is, by reflection primarily from the ceiling and to some extent from the walls. The light sources may be concealed in suspended opaque bowls or very dense bowls of diffusing media. They may also be concealed behind cornices, in capitals, wall boxes, vases, pedestal lamps, or various ornaments.

In practice, we generally have some direct and some indirect light. In many cases we have light sources in direct-lighting fixtures as well as concealed in opaque media. In fact, the combinations are so varied that the classification of lighting systems has become quite impracticable. The terms direct lighting and indirect lighting are helpful but inadequate. As we acquire a broader view of light as a medium of expression, the need for such terms will disappear, owing to their narrowness. When we learn to think of painting with light, we will merely adopt a terminology similar to that used for paint and similar media and will extend it to meet the requirements of this mobile and more powerful medium.

EFFICIENCY AND EFFECTIVENESS

If we consider a fixture from the viewpoint of lighting, we find that there are three elements of light: namely (1) direct, (2) indirect, (3) and decorative. It is easy to determine the percentage of the total light from a fixture which is emitted downward below a horizontal plane through the fixture. The remainder of the light is emitted in a generally upward direction above this plane. If we appraise lighting fixtures in this manner, we find that we are able to form a fairly definite idea of the effect which will be produced in a given interior. This is the place to begin visualizing the lighting effect. If the decorative scheme of one room differs greatly from that of another interior, allowances are easily made. Obviously, the effects produced by the same fixture in the two rooms will differ according to the influence of the two decorative schemes. Inasmuch as the lighting effect is the actual objective, it matters not what system of lighting produces it. The important thing is to select fixtures which distribute the light so that the desired lighting effect is produced in the particular interior in question. Consideration of the lighting along with that of the decorative scheme is the proper procedure. From the viewpoint of lighting effect in the room, determinations of the so-called direct and indirect components emitted by the fixture are all that is necessary.

The element which we have termed *decorative light* consists of light which has already been accounted for in the direct and indirect components in the consideration of distribution of light emitted by the fixture. Some of the decorative light may go upward, some downward, or all downward, and so on. This is the light which is emitted by those visible portions of the fixture having decorative appeal. We may have an opaque cylinder in which a light source is installed. Direct light emerges from the lower aperture and an indirect component from the upper one. This fixture would have no decorative component. If the cylinder is of diffusing glass, the external surface, which is bright, due to diffusely transmitted light, provides what may be termed the decorative component or element of light. Of course, this light is also divided between the direct and the indirect components. We may have combined with an opaque bowl a number of electric candles. Only the shades on the candles provide the decorative light element. Such an analysis of lighting fixtures will be found to aid greatly in the visualization and consideration of lighting effects.

From a utilitarian viewpoint, the direct component is primarily important for lighting specific areas. The indirect component is of importance as secondary lighting which provides diffused light for the shadows, reduces the harshness of the shadows, and illuminates the ceiling and walls, thereby relieving harshness. The decorative component of light determines the vitalizing effect of the fixtures. This decorative light is nearly always essential if a lighting fixture is to be satisfying as a pleasing object whose primary function is that of a lighting device. Totally indirect-lighting fixtures without some brightness suggestive of a lighting device are usually unsatisfying. A fixture is often better from the viewpoint of decorative light if this decorative component consists of a number of sources, such as shades, or of a number of areas divided by opaque portions or produced by superposed denser or lighter design elements. These are important considerations in the design and choice of lighting fixtures for various purposes.

Some philosophizing on the relation of beauty and utility also emphasizes certain neglected features of lighting fixtures. Beauty cannot be considered to be completely separated from utility, as is readily seen on perusing the extensive literature on the philosophy of the beautiful. Usefulness is a part of beauty and, therefore, a lighting fixture cannot be beautiful if it does not fulfil its purely utilitarian purpose, regardless of the gracefulness of its lines or of its expressiveness as a work of art. Beauty is the result of harmony—the accord of all the elements; therefore, when a lighting fixture is intended to fulfil the double purpose of a decorative object and of a utilitarian distributor of light, the fulfilment of the latter aim is essential to harmony and, hence, to beauty.

On surveying the past in lighting, it is easy to imagine the designing artist so engrossed with such elements as form, grace, color, and expression that he neglected the other principal object of the fixture —its usefulness as a *lighting* fixture of modern possibilities. Similarly, it is equally easy to imagine the lighting engineer so occupied with the utilitarian aspect of lighting that he neglected the artistic aspect. It is no easy task for an individual to cultivate both viewpoints to a high degree of perfection. Dual experts of this character are rare, but the harmonizing of pure utility and art in lighting fixtures can be accomplished. The past bears witness in many cases to the absence of such combinations. Lighting fixtures at present, although showing a gradual mingling of these two viewpoints, present a variety of examples which represent the progress of the two extreme viewpoints toward each other. Fixture design has largely evolved from the purely artistic viewpoint, and in this field lies the opportunity for perfecting the harmony of usefulness and beauty in lighting fixtures.

It is not a simple task to combine utility and art, that is, to design the skeleton of a lighting fixture and then to provide it with an artistic exterior. It is satisfying to know that it can be done. If a sacrifice must be made in harmonizing the artistic and the purely utilitarian, let it in many cases be that of efficiency in its narrow sense. The accomplishment of the purely utilitarian and artistic aims simultaneously, even at the sacrifice of some light, results in an efficient unit in the broader sense, because it is more satisfactory.

THE CONTROL OF LIGHT

The term *efficiency* is often misapplied. Wastefulness is unjustifiable, for if it is justified it is not a loss. In those interiors in which the esthetic aspects are prominent, the most efficient lighting fixture is not necessarily the best. In fact, it is seldom the most desirable. On the other hand, losses in lighting which are preventable without depreciating the desired decorative value of the fixture or desirability of the lighting effect cannot be justified. It should be noted that the efficiency of a lighting fixture or of a lighting system is the ratio of satisfactoriness to cost, and not merely the reciprocal of the cost. We should begin with proper principles in a fixture. Efficient reflecting and diffusing media should be chosen when suitable, as well as the most efficient light sources compatible with the effect desired. Multiple reflections in fixtures should be avoided as much as possible, because they may cause the loss of much light. Some silvered mirrors are better than others, and white enamel and paint are usually less efficient than silver. Reflectors are available for any distribution of light desired. Interiors of decorative shades are more efficient if they are white. Attention to details of this sort conserve light where there is no gain through loss. The ratio of the light emitted by a fixture to the total light generated by the light sources represents the efficiency of the fixture in a narrow sense. When we take into account the satisfactoriness of distribution, diffusion, and color of light, and the esthetic appeal, we have effectiveness, or efficiency in a broad sense.

The primary purposes of fixtures are usually utilitarian, that is, to provide lighting of proper distribution and diffusion. Proper tint of light and degree of sparkle are among the lighting purposes of some fixtures. When these utilitarian matters are disposed of, the fixtures may be clothed in a great variety of ways to make them beautiful and fitting. Of course, ornaments vitalized by their own artificial light have just as much right to exist as any other ornament. Therefore, purely decorative fixtures, including portable lamps and various novelties, are not primarily utilitarian. These are restricted by no laws, except those of eye comfort and esthetics. Certainly, these decorative devices are inharmonious if they are causing ocular discomfort by disregarding the need for shading light sources and diffusing the light.

Reflection of Light.—The reflecting characteristics of various surfaces are important in considerations of fixtures and lighting. There are three general types of surfaces, although surfaces exhibit a variety of reflecting characteristics varying throughout the whole range of the three types shown in Fig. 8. In these illustrations I is the incident ray of light and R is the reflected ray.

Regular reflection is that type exhibited by a mirror as shown in Fig. 8. The angle which the reflected ray of light makes with the surface of the mirror is equal to the angle which the incident ray makes with the surface. By warping the mirrors into various shapes as predetermined by optical computations, many desired controls of light are achieved. Figure 9 shows five types of light control with silvered reflectors.

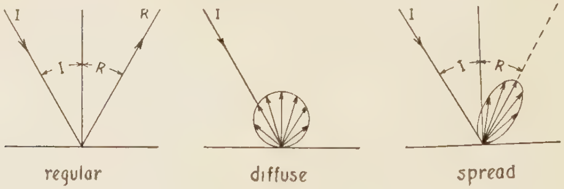

Fig. 8.—Illustrating three types of reflection. From left to right these types are regular, diffuse, and spread reflection.

Diffuse reflection is perfect when the incident ray is scattered in all directions as shown in Fig. 8. Many surfaces reflect light almost perfectly diffusely, such as blotting paper, dull plaster, sand-blasted opal glass, and matte paints.

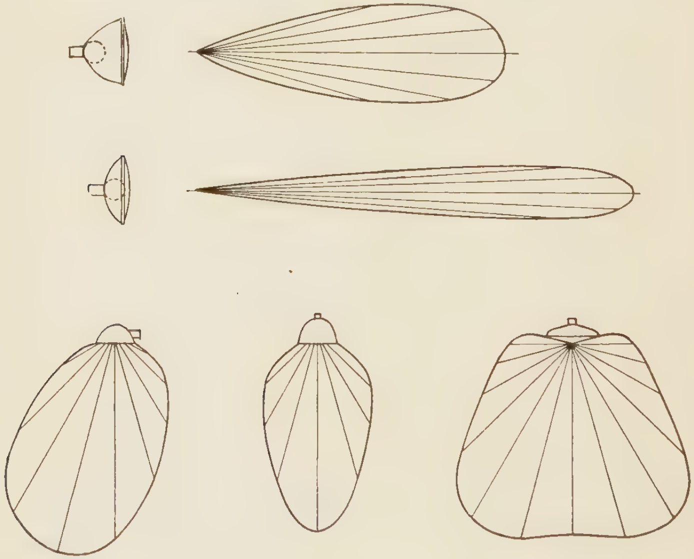

Fig. 9.—Illustrating how light may be controlled by silvered reflectors of various shapes.

Spread reflection is a common type of diffuse reflection which tends toward regular reflection, as shown in Fig. 8. It is seen that the light is more or less diffused, but it is reflected to a great extent in the general direction that the reflected ray would have taken if the surface were a mirror. Surfaces which exhibit this type of reflection are aluminum paint, sand-blasted crystal glass, a choppy sea, and pebbled glass.

Mixed reflection is a term applied to surfaces exhibiting regular reflection superposed upon diffuse reflection, such as results when a sheet of clear glass is placed over a white blotting paper. Other examples are glossy paints, polished wood, and glazed porcelain (see Fig. 10).

Diffuse transmission of light is very important in fixtures and in lighting. Media vary greatly in their ability to diffuse light and there is a close analogy between transmitting and diffusing media. In Fig. 10, *a* represents a ray of light incident upon a diffusely transmitting media. If the surface is glazed, like a smooth opal or milk glass, a few per cent of the incident light will be reflected along the line indicated by *b*. If the surface is sand-blasted, there will be no regularly reflected light, that is, for such surfaces *b* will not be represented. If the medium is a very dense opal glass, much of the incident light *a* will be diffusely reflected, as shown by the longer arrows above the horizontal surface of the medium in I. A smaller amount of light will be diffusely transmitted, as indicated by the arrows below the horizontal surface.

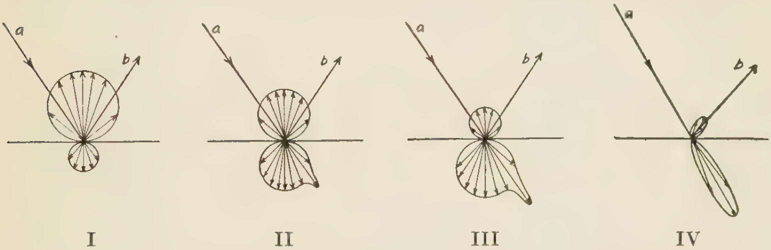

Fig. 10.—Illustrating the reflection and transmission characteristics of translucent media. From left to right these are, respectively, dense opal glass, moderately dense opal glass, still less dense opal glass, and sand-blasted crystal glass. All the glasses have smooth upper surfaces.

When the diffusing glass is of a certain lighter density, it is possible to see the light source. This is indicated in illustration II in Fig. 10. The results of a still lighter density are shown in illustration III. The transmission characteristic of a sand-blasted clear or crystal glass is shown in illustration IV. The transmission is analogous to the spread reflection of aluminum paint. It is seen that a dense opal glass is a good reflector. This advantage can be utilized in lighting fixtures. In fact, transmitting media of glass and of other materials have applications depending upon how much diffusion is desired. If a glass skylight is made of dense diffusing glass, it is seen that the reflected light is likely to be lost. The transmission factor of the densest opal glass illustrated in Fig. 10 is about 20 per cent, the second one is about 50 per cent, and the third one about 70 per cent. Crystal glass sand-blasted on one side transmits about 75

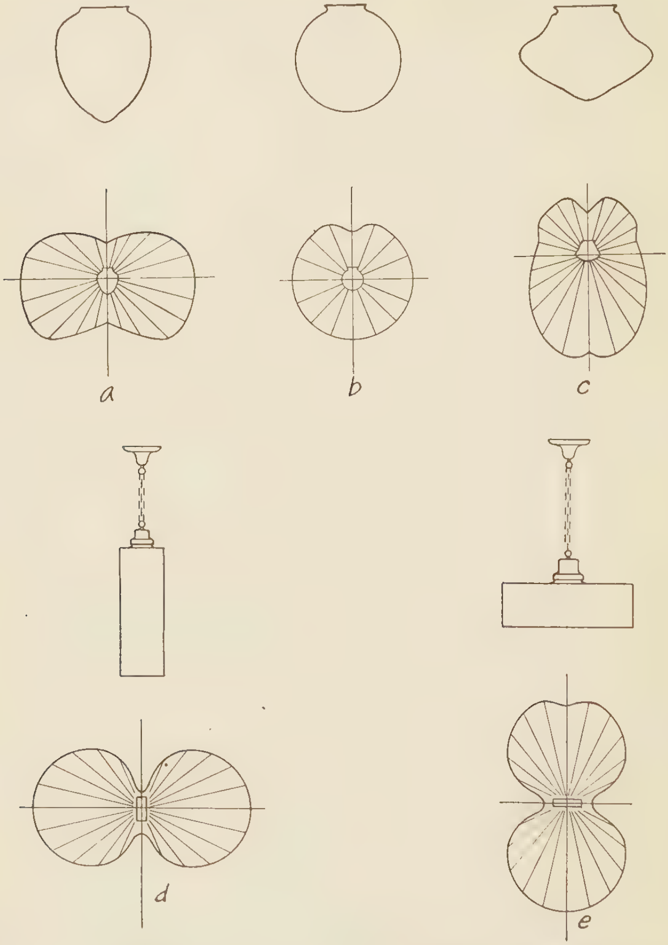

Fig. 11.—Illustrating the effect of the shape of diffusing glass envelopes containing a single light source in the center.

per cent of the incident light. For large angles of incidence up to 50 degrees, the two surfaces of a clear glass reflect from 8 to 10 per cent of the incident light, that is, the transmission factor of a clear glass cannot exceed 92 per cent.

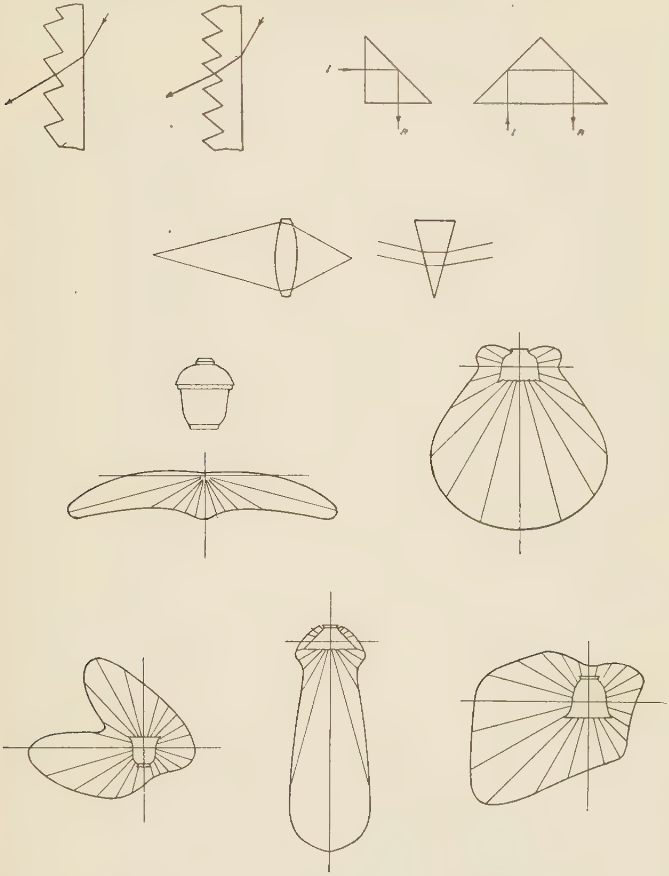

FIG. 12.—Illustrating the control of light by refraction and reflection by various clear-glass forms; below is shown the control of light by various devices made of prismatic glass.

Figure 11 shows some of the distributions of light obtained from totally enclosing envelopes of moderately dense diffusing glass. It is interesting to note the intensity of light in various directions from the diffusing glass envelopes *a*, *b*, and *c*. It is seen that the form is quite influential. If we vary the form extremely, as in *d* and *e*, the influence of form is very striking.

Refraction of light is a property which transparent and translucent substances possess, resulting in an alteration of the direction of light rays. A prism will bend the light rays in a certain manner. A lens is approximately a prism of revolution and it bends the light rays in a definite manner. The paths of light rays as altered by three simple glass devices are shown in Fig. 12.

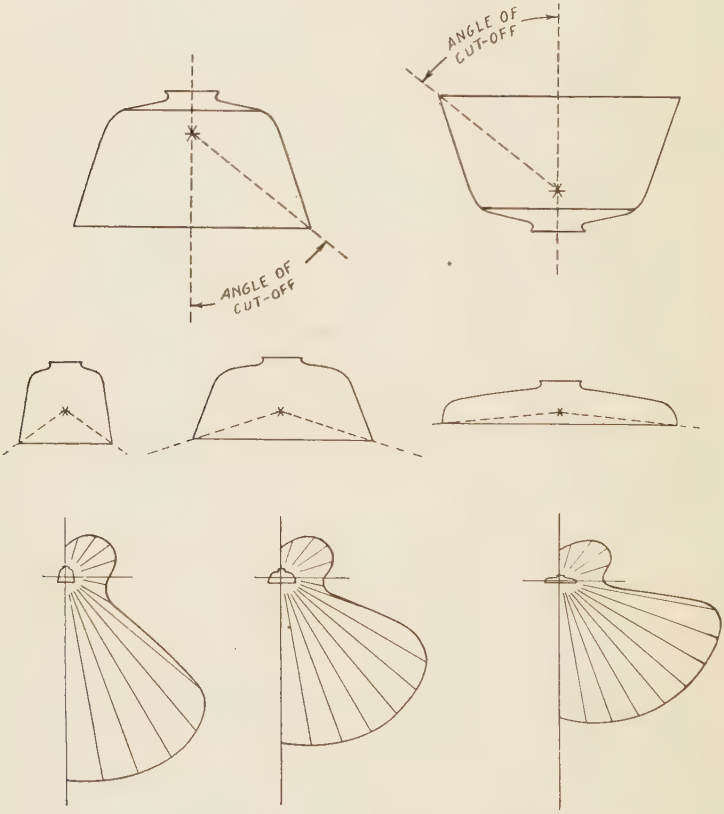

FIG. 13.—Illustrating the angle of cut-off and the distribution of light from opaque reflectors of different forms.

The right-angled prisms totally reflect the light rays as shown, *I* being the incident light and *R* being the totally reflected light. Such simple optical principles as these are combined and multiplied to give us some of the more complex devices for controlling light. Some lighting devices employing the refraction of multiple glass prisms are also illustrated in Fig. 12. It is seen that a great variety of light control is obtainable by these glass "refractors" or "prismatic reflectors."

Shades are chiefly used to intercept all or a portion of the light in certain directions. All shades reflect some light from their inner surface so that the term *reflector* is often applied to them. A shade may consist of metal enameled white inside, of silvered glass or metal, of diffusing glass, parchment painted white inside, etc. These could be termed reflectors, but shades which consist of textiles, parchment, etc. and are not designed primarily for reflecting much light are not included. Clear, cut, and etched crystal glasses do not perform the functions of shades (see Fig. 13).

The angle of cut-off is a very important and useful term. Light travels in straight lines unless altered by refraction or reflection. Light from the source escapes directly through the aperture of a shade, as shown in Fig. 13. If the shade is inverted without changing the relative position of the light source, the angle of cut-off remains the same. The other three shades are of dense diffusing material, like white-enameled metal or opal glass. The angle of cut-off is different in each case. Along with these are shown the three distributions of light. These vary with the angle of cut-off and the shape of the shades, which in this case are really reflectors.

It is difficult to rate the various reflecting and transmitting media in respect to various uses in lighting devices. However, an attempt was made, as indicated in the accompanying table, by E. W. Commery and the author.[1] These ratings in some cases can be no more than approximate, but they are of value to those interested in comparing various media.

In general, reflecting and transmitting media which scatter light are limited in their control of light, although they are very important in lighting and in lighting fixtures where highly directed light and exact distributions of light are unnecessary.

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[1] "Code of Luminaire Design," Illuminating Engineering Society.

TABLE I.—RATINGS OF MEDIA IN RESPECT TO SEVERAL PHASES OF FIXTURE DESIGN AND LIGHTING

	Shading of light source	Diffusion of light	Redirection of light	Transmitting efficiency	Reflecting efficiency
Crystal glass	..	..	VP	E	VP
Etched or sand-blasted crystal glass	VP	P	P	E	VP
Opal glass[1] Dense	G	E	F	F	G
Opal glass[1] Medium	F	G	F	G	F
Opal glass[1] Light	P	F	F	E	P
Cased glass	G	E	F	G	G
Enameled glass	F	F	F	F	F
Silvered glass	E	..	E	..	E
Prism glass Refracting	F	..	E	E	..
Prism glass Reflecting	F	..	E	..	E
Rippled glass	VP	VP	P	E	VP
Porcelain enamel	E	F	F	..	G
Paint enamel	E	F	F	..	G
Polished silver	E	..	E	..	E
Polished aluminum	E	..	G	..	G
Paper (dense)	G	G	F	F	G
Parchment	G	G	F	P	F
Mica (art)	G	P	P	P	P
Textiles (dense)	G	G	F	P	F[2]
Plaster	E	G	F	..	G

E, excellent; G, good; F, fair; P, poor; VP, very poor.

[1] Three grades of opal glass are assumed according to their ability to diffuse light. These have characteristics similar to those illustrated in Fig. 10.

[2] For the lighter colors.

ILLUMINANTS

The electric-filament lamp is so generally adaptable, owing to its simplicity, safety, luminous efficiency, and variety of size, that it is now almost universally used for the lighting purposes which are considered in these chapters. The standard lamps available represent quite a range in natural tint from the warm yellow-orange of the candle flame to the whitish light of the so-called "daylight" lamp. When any one of these lamps is used by itself the tint is noticeable, but the greatest effectiveness is obtained by contrasting them. For example, certain areas illuminated by light from daylight lamps appear very bluish by comparison with areas illuminated by light from the ordinary lamps, or particularly from the flame-tint lamps. A ballroom, a restaurant, or the living room of a home is the ideal place for the use of the warm light from lamps of a flame-tint. Paintings, stained-glass windows, and many objects whose colors should be revealed with more or less fidelity are best illuminated by the so-called daylight lamps, which provide light approximating average daylight.

OBTAINING COLORED LIGHT

It is not the intention to delve deeply into the science of color, but it seems best to present some data pertaining to the spectrum in order that the possibilities of colored media may be better understood. Colored glasses are the only permanent colored media for lighting purposes, and it is better to utilize colored-glass accessories wherever possible than to use colored lamps. Many devices of this character have been developed recently, so that some of our dreams pertaining to applications of colored light may now be realized.

As is well known, the radiant energy from an incandescent filament contains all the primary colors. Colored light results if we interpose between the filament and the illuminated surface some medium which absorbs the energy in certain spectral regions. The eye is not analytical, and two colored lights so obtained may appear identical in color when compared on a white surface, but they may be entirely different in spectral character. For example, yellow light may be produced by subtracting from the radiant energy all spectral colors except the yellow, or except the red and green in the proper proportions. However, an object which appears yellow when viewed under white light might have a totally different appearance under these two "yellow" lights.

The limits of wavelength for the spectral colors are somewhat indefinite. An observer's choice of limits for a particular color depends to some extent on the experimental conditions. This is not surprising when it is considered that more than one hundred different hues may be observed in the dispersed spectrum under proper conditions. The most definite colors, with their approximate spectral limits, are given in the first two columns of Table II. In the third column are given data showing the percentages of the total light from a 150- or 200-watt gas-filled lamp which are within these spectral regions. These data are based on the standard visibility data and a color temperature of 2800°K. for the filament.

TABLE II.—APPROXIMATE WAVELENGTH INTERVALS FOR CERTAIN SPECTRAL COLORS, AND THE PERCENTAGES OF THE TOTAL LIGHT FROM A 150- OR 200-WATT LAMP WHICH IS OF THOSE PARTICULAR COLORS

Color	Approximate spectral region	Per cent of total luminosity
Violet	0.400–0.430μ	0.01
Blue	0.430–0.485	1.5
Blue-green	0.485–0.502	2.0
Green	0.502–0.530	10.7
Yellow-green	0.530–0.563	25.3
Yellow	0.563–0.590	26.6
Orange	0.590–0.620	22.4
Red	0.620 to limit	11.5

It is evident that any change in the spectral limits assigned to a particular color will result in a change in the luminosity value given in the third column; however, the data given in the table are approximately correct.

Certain spectral colors are more "colorful" than others, that is, a smaller amount of the color need be added to white to produce a distinguishable tint; expressed in another way, a very "colorful" color will stand a greater dilution with white light or a less "colorful" color without losing its color identity. The following is approximately the order of "colorfulness" of the primary colors: red, violet, blue, orange, yellow. This order is based upon the purity of color as obtained by practicable colored media and not upon monochromatic colors isolated from the spectrum.

From a consideration of the luminosity in various portions of the spectrum, and the "colorfulness" of various spectral regions, some idea may be gained as to the maximum efficiency of production of colored light which may be expected. In general, colored glasses, gelatines, etc. do not give pure colors. For example, if a certain medium transmitted only the spectral red, its maximum transmission when used with a gas-filled lamp would be approximately 11 per cent. Red is very colorful, however, and a considerable amount of orange and yellow light can be transmitted without loss of the predominant red hue. Thus, a very fairly satisfactory red can be obtained with a luminous efficiency of about 15 to 20 per cent. In addition to the advantage of the higher efficiency, there is often a further advantage, in that objects which reflect no red light do not have the brown or black appearance in the dilute red light which they would have in a pure spectral red light.

There are three general methods of producing colored light: (1) colored-glass bulbs, (2) colored accessories (glass, gelatines, etc.), and (3) superficial colorings. In comparing the relative merits and fields for these various methods, many viewpoints must be considered. Some of these are discussed here with the hope of aiding the user to choose the method best suited to his purpose. Demands for natural colored-glass lamps often arise from a lack of acquaintance with colored-glass accessories, which, in general, offer a better solution and which in many cases prove to be less expensive and are more easily maintained.

Colored-glass bulbs are available, in a limited range of colors, but, in general, most of the problems involving colored light can be solved without the use of such bulbs, which are necessarily expensive. Their use is justifiable in some cases, *e.g.*, where space is extremely limited or other special considerations enter, but in most cases colored-glass accessories or superficially colored bulbs represent better practice.

Colored-glass accessories are now available for use with incandescent lamps to produce colored light in the show window, on the stage, in signs, and for displays of many types, both exterior and interior. Wherever the installation is of a more or less permanent character, such accessories should be used if possible, since the renewal part is merely an easily obtained regular lamp. The glass is permanent in color, hence the maintenance is simplified and the user is saved the trouble and expense of obtaining special colored lamps. These glass accessories are of various kinds, some of which are illustrated in Fig. 14.

Colored-glass caps are available in various sizes and colors for use in electric signs. The smaller sizes usually have spring clips which hold them on the lamp bulbs.

Colored-glass globes are available with a number of types of holders which adapt them for use with reflectors of prismatic glass of silvered glass and of porcelain-enamel reflectors. These may be used with high-wattage gas-filled lamps for show windows, footlights, border lights, cove lighting, billboards, and in numerous other places where colored light is desired.

Reflectors and projectors, with colored-glass plates or lenses in the aperture, are available for many purposes. They have been used on the stage, in large interiors, and for flood lighting. In addition to these previously mentioned colored media, colored glass, lenses, roundals, sheets, globes, etc. are available for various purposes.

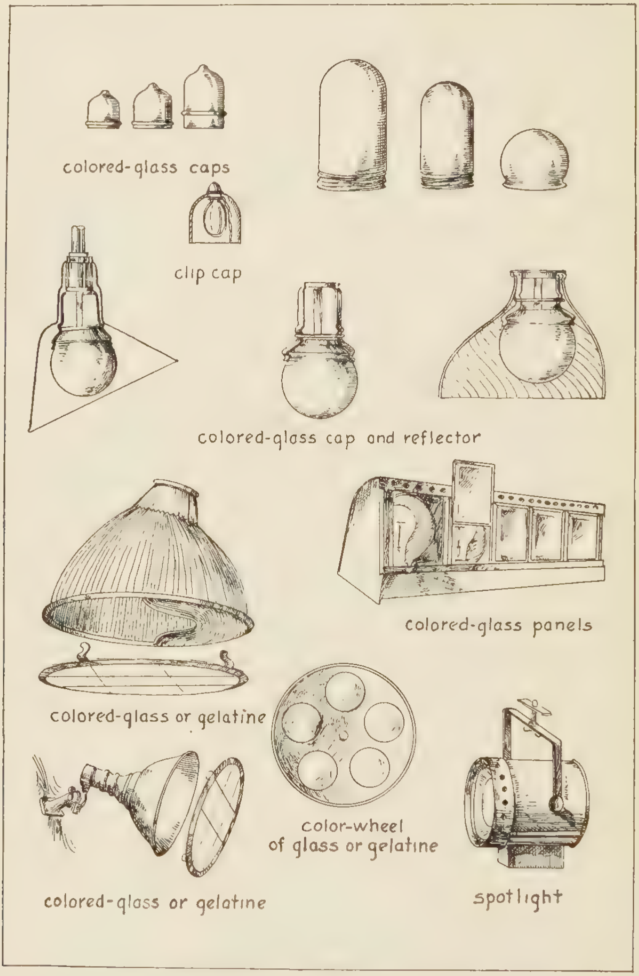

Fig. 14.—Illustrating colored accessories of glass and gelatine which are available

Colored gelatines of various tints and pure colors are quite satisfactory for many temporary installations. Many of these are not permanent in color, however, and they also become brittle after being used for a while. Practical devices of this character are becoming more generally available, and may be used very satisfactorily instead of colored-glass bulbs in many applications of colored light. The colored glass and gelatine accessories may be obtained in relatively pure colors, such as red, deep-amber, canary, green, and blue. Tints are obtainable by mixing uncolored light with pure colored light. In some instances they are also obtainable from a single unit by using pieces of colored glass on a colórless diffusing glass.

Superficial colorings for tungsten lamps may be subdivided into: (1) solutions in which the lamp or device is dipped, and (2) liquids containing suspended pigments which are sprayed on the lamps.

The solutions applied by dipping usually consist of analine dyes dissolved in a celluloid or varnish vehicle. It is also possible to grind insoluble coloring materials, such as pigments, fine enough so that they will be held in suspension in these vehicles. The analine dyes fade under the influence of heat and light, hence these dips are unsatisfactory for large lamps, due to the bulb temperatures encountered. Some of these fade even with lower-wattage vacuum lamps, but many of them may be used with fair satisfaction with these lamps. Even the vehicles used for dissolving the dyes usually disintegrate or scorch when used on the higher-wattage lamps. Hence, even if the coloring material is a permanent pigment, the permanency of the coating is dependent on the vehicle. The analine dyes provide fairly pure colors, and by mixing and diluting them a great variety of tints is obtainable. The lamp dips must be fairly pure in color if tints are to be obtained by mixing them. These dips usually give a transparent coloring, though some give some diffusion.

The spray method was developed by the author and H. D. Blake in order to be able to use materials which would be permanent on large lamps. The insoluble but permanent coloring materials were finely ground and suspended in a vehicle which was found to be permanent. Thus permanent diffusing and coloring materials are combined with a permanent vehicle. Experiments indicated that tinted light could be obtained efficiently in this manner, for example, the flame-tint lamp, but that the more or less opaque insoluble coloring media would not yield relatively pure colored light at the highest possible efficiencies. The color of a pigment is usually different when seen by transmitted light rather than by reflected light. It is quite probable that, when such a pigment is used in a sprayed coating, a portion of the light gets through by multiple reflections between the minute insoluble grains of the pigment. Hence, extremely pure colored lights, such as red, green, and blue, cannot be obtained by this process when these more or less opaque coloring materials are used. Even colored light of the deeper tints is produced less efficiently by this process than by means of dyes or colored glass. However, this process is applicable to larger lamps than the dipping process and results are more permanent. Also, the light is well diffused, and the lighted lamp has a much better appearance than a dipped lamp with colored transparent coating. These lamps may be used with satisfaction where it is inconvenient or unsatisfactory to use colored-glass accessories. They are more satisfactory as to permanence of color and coating than are the dipped lamps.

Since colored light is more attractive and psychologically more powerful than colorless light or lights of natural tints (candle flame, daylight, etc.), the intensities required are not usually as great as for colorless light. The transmission factors for colored glass and gelatines which provide colors of the purity demanded in practice when used with the gas-filled tungsten lamps are as follows:

	Per Cent
Red	10–20
Yellow	30–60
Green	5–10
Blue	1– 5

The red is a fairly pure hue. The lower value for yellow is for a deep amber or an orange and the highest value is for canary yellow. The green is a yellowish one and of fairly high purity. A deep-blue cannot be obtained without sacrificing more than 98 per cent of the light, that is, the transmission factor is between 1 and 2 per cent. In practice, a compromise is made, so that enough light is obtained by using blue filters having transmission factors as great as 5 per cent. These provide blue light which is not of high purity, but is about a medium tint.

It is not difficult to utilize colored-glass accessories in lighting fixtures and in connection with reflectors which are concealed behind architectural ornaments or in recesses specially constructed. Uses of them are shown in later chapters.

DECORATIVE GLASSWARE

We shade our eyes from the sun, we turn our back to it, and we like the shade, but, notwithstanding these reactions outdoors, most persons are indifferent to bare and glaring light sources at home and in similar environments. Glare from bare light sources or from light inadequately diffused is annoying and discomforting. Such conditions cause eye strain, fatigue, and various disorders which are well known to arise from misused eyes. Light is necessary for most activities, but it cannot do its best for us if we are indifferent to its use. It is so essential that it is deserving of being desirable. It cannot be adequately desired if it is improperly used.

No one ever thinks of purchasing a portable lamp without a shade or of using it without one. Why, then, do we find so many lighting fixtures without proper shades? Perhaps it would be best to rest this portion of the case with that question, but lest we find a harsher answer we offer the word *indifference.* Surely, we should not be indifferent to such an essential as light. Perhaps indifference would be justifiable if we did not have ready at hand such satisfactory equipment as illuminating glassware. In general, no medium has successfully competed with glass in diffusing and in shading light in homes and in many other fields. It is inexpensive; it is durable; it is easy to clean; it is efficient; and some of it is attractive.

Let us now consider briefly the artistic features of lighting. The artistic phase of a piece of illuminating glassware involves shape, size, color, diffusion, and ornament. Glass is susceptible to proper treatment in all these respects. The possibilities of modern lighting have awakened some of the leading manufacturers of illuminating glassware to their responsibilities, and suitable glassware is now available which refined tastes can accept. The best decorative glassware is no longer merely glass. It is of proper size and diffusion. These two factors determine the brightness, which must be comfortably low if the fixture is to be beautiful in the broadest sense. The shape is not only to be considered from the viewpoint of form, as in art, but it must be such as to conceal the light sources from the eyes properly. Here again the fixture cannot be artistic when lighted if it does not fulfil its utilitarian object. Ornamentation is quite a matter of taste, but when in doubt simplicity is a safe rule. The color of illuminating glassware is somewhat a matter of taste and of harmony with surroundings, but not entirely so. In general, warm tints should predominate. Among these are variations of yellow-orange, brown, and rose. We more generally like light of such warm tints than cold ones, such as blue and green. This applies only to the predominant or general color of the glassware. Ornamentation which covers a relatively small area is not subject to this restriction.

Viewing the best decorative glassware that has recently appeared on the market, perhaps we are surprised most by the fact that its general appearance differs so markedly from that to which we have been accustomed. Manufacturers have introduced wonderful "textural" improvements not only in the glass itself but also by superficial finishes. Other glassware that was merely glass forced persons of discriminating taste to the use of fabrics and parchments. The textures of fabrics do not grow old. We do not tire of the elusive texture of parchment. The subtle variety of such textures has been with us for centuries without becoming offensive. Likewise, the subdued grains of wood and the almost imperceptible texture of certain stipplings of paint are ever pleasing. By introducing such effects and many others in illuminating glassware, the doorways which were closing upon glassware are again opening.

This new decorative glassware is important because it means that we can diffuse and shade light with inexpensive and durable glassware which is attractive. Thus, we can make our lighting comfortable and charming and our fixtures pleasing to look at. And what is more attractive than ornament vitalized by light? We purchase a vase or any other piece of ornament for the pleasure it gives us in looking at it on the mantel or elsewhere. Its charm depends upon certain factors which are also involved in illuminating glassware. It has shape, size, color, and ornamentation. It may serve a purely useful purpose, but often it does not. Proper illuminating glassware has all these characteristics and it *always* serves the very useful purpose of eliminating eye discomfort. It softens shadows and subdues the lighting. It spreads its influence over the entire room. Besides all this, decorative glassware is enlivened ornament, vitalized by light which it divests of its glare and harshness. We should welcome this new glassware with enthusiasm because it is charmingly useful.

This does not mean that mica, parchment, and textiles do not have many applications. In their proper places they are excellent, however, the properties of illuminating glassware make it a more practicable medium for shading and diffusing light for most lighting purposes.

CHAPTER VIII

HISTORICAL BACKGROUND

Although the great possibilities in lighting fixtures and lighting effects of the present time are due to the luminous efficiency and controllability of the light from modern electric-filament lamps, the extensive background of preceding centuries is important in various ways. Mankind has inherited much from Nature and in Nature are found the inspirations for man-made things. The natural world was awaiting the arrival of man. He could not alter its laws, but he could adapt them to his use. From the very earliest centuries of the sojourn of the human race, man showed a tendency to superpose upon the natural world an artificial one of his own creating. This tendency is expressed even in primitive man by his use of tools, the building of crude huts, the subjugation of animals, the cultivation of soil, ornamentation, and the use of fire for heat and light. Every century inherited its past. The pathway of civilization down through the vista of centuries is marked by the milestones of progress in Science and in Art.

Art far outstripped Science in development, for it reached great heights thousands of years ago, whereas Science began to attain eminence only recently. The production of artificial light is a good example of this comparison. The classic art period in Greece was illuminated by the feeble flames of smoking oil lamps. The splendor of Roman art came and went with little or no progress in light production. The marvelous Gothic structures of the late Middle Ages were faintly illuminated by flickering flames from oil lamps and candles. The invention of the lamp chimney was still three centuries in the future. The Great Revival in Art, which reached its height during the patronage of Louis XIV, was still the age of candles. The crystal chandeliers of glittering splendor executed in the royal ateliers of this and even later periods reflected the feeble but fascinating lights from candles which differed little from those which burned at the birth of Christ.

Down the ages, wave after wave of artistic expression swelled to great heights and receded, but each passage left for posterity much of beauty which inspired new generations and much which will live eternally in the heart of mankind. But through all these ages the production of artificial light did not rise in method above that of the fire of primitive man. Light was produced by burning something. It is true that the material burned was refined more and more, but for two thousand years after the creation of the wonderful architecture of Greece there was relatively little improvement in light sources. They remained crude insignificant flames—inadequate for lighting and impracticable for lighting effects—limiting light as an expressive medium. It is distressing to view the exquisite lighting fixtures in this manner, for one feels almost sacrilegeous. However, we bow humbly to the artistic aspects of those heritages, while we rate them low from a scientific viewpoint in comparison with the present practicable efficient light sources which give us such control over light.

Science in very recent years has given us light sources which have ushered in a new age in which will be developed a new art to be added to the others which make interiors attractive—the art of the expressiveness of light. Michelangelo died the year that Galileo was born. One might fancy the scepter passing from Art to Science, because few achievements in later Art were destined to transcend those of the versatile artist who had passed away; and Galileo was to lay permanent foundation stones for Science. The great Isaac Newton was to discover the spectrum and lay the foundation of the science of light and color. From these beginnings the wonderful light sources of today developed. Science has done its work well, and from its labors the lighting artist is being born.

Beautiful buildings, artistic interiors, individual works of art, which to some extent are heritages of a glorious past in art—many now live after nightfall not only to be satisfactorily seen at night, but to be rendered even more charming by controlled light. But to do adequate justice to these productions of man, the lighting artist must feel something of the spirit of the ages which are perpetuated in them. He must see in his imagination something of the life of those periods. For example, in the period church he should sense the underlying principles of the creed and of the intellect and character of those who established it. He should experience the emotions of the worshippers who toiled to build edifices from which this church evolved. He should know the character of those people and how they struggled, enthused, sorrowed, and sacrificed. He should be familiar with the light sources of the time and how they were used. He should know the symbolisms of light, color, and light sources. In fact, there are many details, some dimmed by time and others living vividly in usage, in the historic background upon which the lighting of a church must be built if it is to be perfection. Ornament, architecture, and a definite character and spirit must be harmonized for an interior of this sort.

So it is with other interiors in which the past is living. In the residence, ballroom, theater, museum, and in many other places, the languages of light, color, ornament, and architecture speak understandingly to persons who have learned the meanings. Therefore, lighting is intricately involved with historic past and those who would practice in these fascinating fields of modern lighting should acquire a knowledge of art and of civilization similar to that possessed by thoroughly qualified architects and decorators.

Symbolisms may be retained with fidelity where they are a matter of ritual, but each new era modifies the usage of the preceding period to the extent which mankind desires or permits. The symbolisms of candles in Catholic churches are manifold, but in some cases electric lamps have replaced candles. If the candle is merely symbolic, its symbolism may be transferred to an electric candle by the consent of those in authority. Thus, practicability alters that which is representative without loss of effectiveness. In other places, where there is no ritual except that sense of loyalty to past practice, the changes are made as a matter of progress and adaptation to the new order of things. Still in all these byways we meet the customs of bygone people and the heritages of their art. The character of the light source had much to do with the form and the construction of the lighting device or fixture. Many of these were beautiful ornaments, upon which were expended the devotion of artists and craftsmen. We may retain them in modern reproductions of the periods in which they existed, but not unalterably if they are unsuited to the present standards of comfortable, useful, and artistic lighting. Nothing could be more appropriate than the originals or copies of them, provided they cannot be improved.

All art is in a state of flux, not only because of the individualistic touch of the creative artist, but also because of progress in science. Therefore, in adapting fixtures of bygone periods to interiors of the present time which are based upon those periods, we are not breaking faith. It is not offensive or sacrilegious to progress. The great advance in light production, which quite recently abruptly altered light sources from the flames of countless centuries to an incandescent filament enclosed in a glass bulb and heated by electricity, has greatly extended the possibilities of lighting. Are we to forego the utilization of the powers of modern light and sacrifice ourselves to the discomfort of inadequate and improper lighting by a dogmatic fidelity to fixtures as they were designed for the flames of harmless brightness and low luminous intensity of yestercentury and the preceding ages? Are we to go forward with the other developments which make interiors more comfortable, and mark time with lighting?

The activities of the present civilization are much more complex than those which have passed. Each score of years exhibits a noteworthy increase in complexity. Our activities after nightfall, or out of reach of daylight, are almost infinitely more extensive than they were in the ages of candles. Then, except for relatively few social functions, nightfall found most persons at home. Reading was a rare accomplishment. The highways were infested with thugs. The family convened around the fireplace and bedtime arrived early. Daylight saving was generally practiced. Poor lighting sent the people to bed to arise with the dawn. Night life was not on the schedule of most persons. Among the contributions which modern artificial light has made to humanity are the extension of the period of recreation, continually operated industries, and non-stop transportation. In this new régime artificial lighting should do its best, and it cannot do so if handicapped by dogmatic fidelity to minor details in art. This is the kind of argument which is behind new designs in lighting fixtures, even for interiors of period style. In many cases the incorporation of modern devices need not radically alter the exterior designs inherited from the corresponding periods. In others, new forms must be devised, but even these forms may possess the spirit of the proper period and be perfectly adapted ornamentation, so that the loyalty of the artist should be satisfied.

Therefore, chapters on period styles are appropriate and even necessary for a background for other chapters in this book. It is with some trepidation that the author enters this field because space does not permit an exhaustive treatment. Although it is the intention that other portions of this book will be creative and instructive by providing new data, new designs, new view points, and, particularly, a definite idea of the possibilities of lighting fixtures and the potentiality of light, it is not assumed that the chapters on period style will be more than helpfully suggestive in relation to other chapters. Certainly, many volumes are available which treat ornament and period styles exhaustively. It is to such books as those by Meyer, Speltz, Clifford, and Hamlin that the reader must go for adequate treatments. Still, there are many readers, to whom the present work is addressed, who should welcome brief discussions of period styles and particularly the illustrations which have been garnered from the past or have been purposely designed as representative. Therefore, we pause in the progress of the primary purpose to survey briefly the historical background.

How to treat briefly the art of bygone centuries is a serious problem. It is a subject which encompasses a large part of the accomplishments of mankind. There are no clear-cut dividing lines. If there had been only one race and it had moved onward in a straight pathway, the divisions would be clearer, but even then they would not be clearly defined. Artistic expression has its influences just as other activities. It depends upon the fortunes of a people; that is, upon economics, education, religion, geography, and other factors. Besides these influences, we have the complexity of many peoples branching forth here and there; governed by rulers good and bad; conquering other nations and being conquered; driven into less fruitful lands; forced to acquire new skill with new materials; mingling with other nations with different ideals; and molded by many other factors. As we look down sixty centuries of recorded history (much of it recorded in architectural ornament), we find a fluid humanity, seething and surging, branching here and there, and growing more and more complex.

To follow the sequence of the developments in art is difficult unless we are skilled in following a number of highways at the same time. Even then there are numberless byways. The divisions may be made geographically, nationally, or temporally.

None is satisfactory unless the treatment is to be exhaustive; however, for the present purposes it seems that temporal divisions are most satisfactory. Therefore, in the following chapters, some brief comments pertaining to various period styles are made under more or less arbitrary divisions, such as Antiquity, Classical, Middle Ages, and Renaissance. The dates of the divisions are quite open to discussion and, therefore, also the period styles included in some of them. These are minor matters, however, from the viewpoint of the purpose of the chapters.

The earliest civilization of which we have much knowledge is that of Egypt, extending backward to 4000 B.C. We have glimmerings of Chinese art beyond 3000 B.C. and of Indian art to 2000 B.C. Besides these our Antiquity group consists of Babylonian, Assyrian, and Persian. From these (excluding the Indian and Chinese) it is possible to find our way to the art of early Greece.

Grecian art extended from 2000 B.C. to the coming of the Roman conquerers and during the latter part of this era the great Classical period in Greece reached its sublime heights. The impressive period of Roman art extends from 450 B.C. to 450 A.D. The Classical period includes the splendid art of Greece and of Rome and the Pompeian offshoot.

Then came the Dark Ages of western civilization. After the decline of Roman splendor the creative spirit was dormant for centuries. It is true that Byzantine and early Christian art was developing, but western civilization was more or less in a state of lethargy for centuries.

During the Middle Ages Mohemmedan art began; Scandinavian art was developing; Celtic civilization was reaching its heights. The important period to us was the Romanesque, in which the earlier Roman art was influential and Christian art was revived. The revival of Christianity gained momentum until, from its fervor, the great periods of Gothic art arose in France, England, Germany, and Spain, leaving behind the marvelous cathedrals.

Then comes the Great Revival in art—the Renaissance. The classical art of Greece and Rome were studied. Out of the inspiration of these forgotten works new period styles arose. We may trace this revival through Italy and into France and Spain. The French Renaissance merged into the periods of Louis XIV, Louis XV, and Louis XVI, which gave us much of lasting beauty. In another direction we may trace the Renaissance through German, Flemish, and Dutch art and into the English Renaissance, which was begun by the Elizabethan and Jacobean periods.

The art of the Renaissance in France reached creditable heights in the period of Louis XIV. Tracing it further in France, we pass the Louis XV and Louis XVI periods. The excavations of Pompeii and Herculaneum gave new impetus to classic revival. Then the French Revolution was followed by the Directorate and Empire periods. The latter was the intense but short-lived era of Napoleon I. In England, the Flemish influence extended into the periods of Charles I and II and of William and Mary. The Queen Anne period acquired something from the Far East. The early Georgian period borrowed from the exquisite productions of the Louis XIV. Chippendale drew something from the Chinese. The Adam brothers returned to the ruins of Pompeii and of Greece and Rome and from these inspirations they left their mark indelibly upon the late Georgian period. Then we find our own Colonial borrowing from Georgian, Louis XVI, and Empire periods and also directly from southern Europe, combining much of these into the only extensive period of which our country can boast in the neoclassical age. In the southern and southwestern portions of the United States the Spanish left their influence in early architecture.

Then we come to the Modern Age. It is too early to appraise the art of this age. We need not describe it, for it is with us. Most of it consists of modifications of previous periods. We have many marvelous buildings, even though they have not yet acquired a just appreciation which is their due. Apparently, the hand of antiquity must caress them before they may acquire distinction. Time seems to lend enchantment. Or is it necessary for the years to pass by in sufficient number for us to gain perspective? Are we too close to appreciate the many beautiful works of architecture which we possess in this country? It is true that the percentage is small, but that would be true in any country if the structures older than this country were eliminated.

IMPORTANT PERIODS IN ART DEVELOPMENT

Antiquity

Egyptian: 4000 to 300 B.C. Conquered by the Greeks in 332 B.C., by Romans in 30 B.C., and by Mohammedans in 640 A.D.

Chinese: 3500 B.C. to present time. Confucius 500 B.C.

Japanese: 1200 B.C. to present time. Empire established 660 B.C.
Indian: 2000 B.C. to present time. Brahman 1400 to 500 B.C. Buddha 500 B.C. Invaded by Mohammedans about 700 A.D.
Assyrian: 2300 to 550 B.C., including Babylonian 600 B.C.

The Classical Age

Grecian: 2000 to 146 B.C. Conquered by Romans.
Roman: 450 B.C. to 450 A.D. Borrowed much from Greece.
Pompeian: 100 B.C. to 79 A.D. Greek and Roman art.

Middle Ages

- Byzantine: 300 to 1000 A.D.
  - Early Christian: 300 to 600 A.D.
  - Oriental: 550 to 800 A.D.
  - Classic: 800 to 1000 A.D.
- Mohammedan: 600 to 1500 A.D.
- Romanesque: 700 to 1100 A.D. Influence of early classic Roman and Christian.
- Gothic: 1100 to 1500 A.D.
  - French: 1100 to 1500 A.D.
    - Early: 1100 to 1200 A.D.
    - Flamboyant: 1300 to 1400 A.D.
  - English: 1200 to 1500 A.D.
    - Perpendicular: 1400 to 1500 A.D.
    - Tudor: 1500 A.D.
  - German, Italian, and Spanish: about 1250 A.D.
  - Moorish: 700 to 1400 A.D.

The Renaissance

- Italian Renaissance: 1400 to 1650 A.D.
- French Renaissance: 1500 to 1800 A.D.
  - Louis XIV: 1643 to 1715 A.D.
  - Louis XV: 1723 to 1774 A.D.
  - Louis XVI: 1774 to 1793 A.D.
  - Empire: 1804 to 1814 A.D.
- German, Flemish, and Dutch Renaissance: about 1500 A.D.
- English Renaissance: 1500 to 1800 A.D. Italian artists employed until Reformation in 1534 A.D.
  - Tudor or Elizabethan: 1509 to 1603. German and Flemish influence during the reigns of Henry VIII, Edward, Mary, and Elizabeth.
  - Jacobean: 1603 to 1689 A.D. Influences same as in Elizabethan. Reigns of James I, Charles I, Charles II, and James II.
  - Queen Anne: 1689 to 1714. Dutch influence during the reigns of William and Mary, and Anne.
  - Georgian: 1714 to 1820 A.D.
    - Early: 1714 to 1727 A.D. French influence, Christopher Wren.
    - Middle: 1727 to 1760 A.D. Chippendale. Chinese influence.
    - Late: 1760 to 1820 A.D. Adam, Sheraton, Hepplewhite. Early classical influence.
- Colonial: 1720 to 1820 A.D. Adaptation of Georgian, Louis XVI, Empire.

(The Empire, Late Georgian, Colonial, and L'Art Nouveau belong strictly in the Modern Age.)

CHAPTER IX

THE ART OF ANTIQUITY

Design and ornament may be traced far into prehistoric times, but these early beginnings are only of passing interest from the viewpoint of this book, which aims only to discuss briefly the periods of civilization which are of chief importance to us in modern life. However, some comments pertaining to the early efforts of primitive man aid in establishing a true perspective. The relics of peoples which lived over 6,000 years ago are ornamented. Certainly, design and ornament had their beginnngs thousands of years before these relics were made. The picture writing of primitive beings perhaps was a great influence in design. Another form of writing was by means of signs or symbols. The Chinese 4,000 years ago represented each word in their language by a symbol. Thus, design in those early times had a utilitarian basis. There is a similarity among the designs of primitive peoples, but perhaps this is due to their elementary nature. This is naturally true, because fundamental elements must be the same. Ornament is a product of civilization and becomes more complex as civilization progresses. Therefore, it is natural for ornaments employed by various peoples to differ widely.

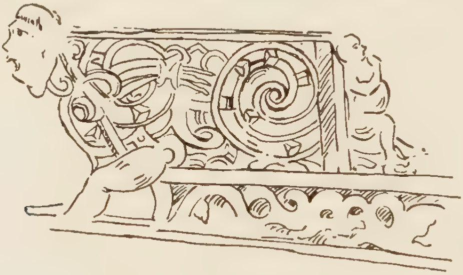

FIG. 15.—Prehistoric.

We can trace ornament back through the Metal Age and into the Stone Age. Creditable drawings and paintings in color have been found which appear to have been executed 25,000 years ago and many ornamented implements, pebbles, bones, etc. have come down to us from periods throughout the Stone Age (see Fig. 15). We think of this age as extending from 35,000 years ago to within 5,000 years of the present time. This is true when we are thinking of the ancestors of our European ancestors; however, when North America was discovered the Indians were just emerging from their Stone Age. The Esquimo of today, left to his own devices, represents fairly well the civilization of the Reindeer Man of 35,000 years ago. The early part of the Stone Age is the Paleolithic. During this period practically the only material used for implements was stone. During the Neolithic or later portion of the Stone Age the tools were more or less artistic, and such refinements as polish and pure ornamentation became more common. Clay also came into use for vessels (see Fig. 16).

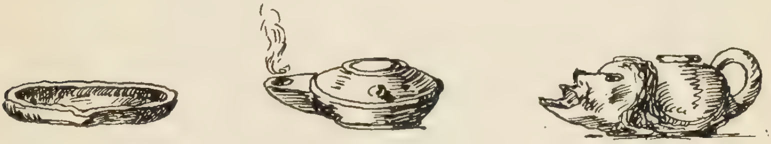

Fig. 16.—Primitive oil-lamps.

The Metal Age began with the use of bronze, perhaps at about 5000 B.C. Bronze came into Europe from the East about 1500 B.C. The Iron Age began about 1000 B.C., perhaps in Assyria. It was not long before iron became extensively used for implements of all kinds (see Fig. 17).

Ornament in those primitive times may be said to have been largely geometrical in character. The drawing and modeling of figures of plants, flowers, animals, and human beings are the products of more accomplished artists, and, therefore, did not come into generous use until later civilizations.

The light sources of prehistoric periods were doubtless merely burning material (see Fig. 18). To what extent these materials were refined is a matter of conjuncture. The earliest beings who used fire no doubt burned material as it was found. As intelligence increased, it seems reasonable to assume that judgment entered into the selection of Nature's materials. Finally, materials were more or less refined and light sources were devised which were the forerunners of the later oil lamps and candles. Instead of merely burning a fat bird or fish, it was wrapped in

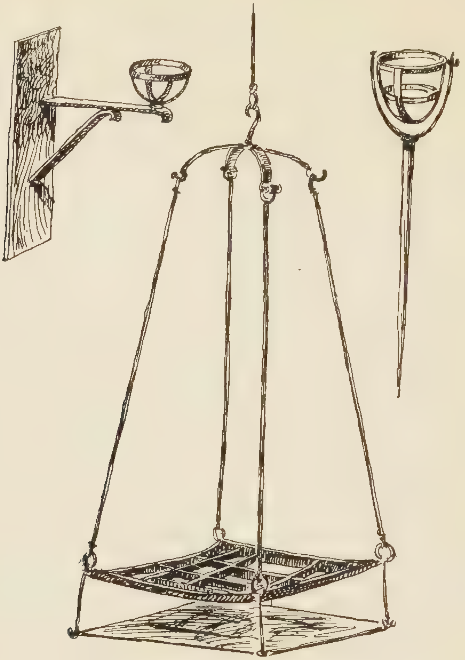

Fig. 17.—Primitive fire-baskets.

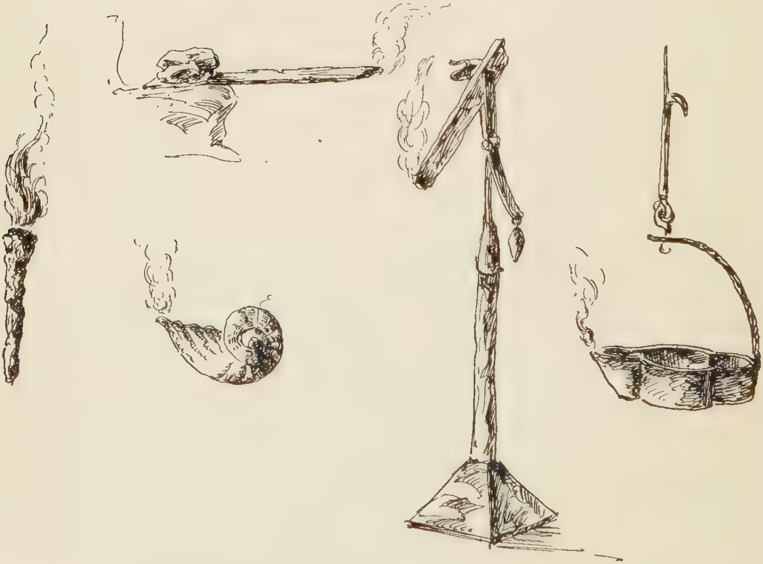

Fig. 18.—Primitive light sources.

fibrous plants. Thus, we have a crude candle with the "wick" outside. Among the early light sources which persisted until recently in the peasant huts was the burning splinter. With the introduction of iron, the splinter holder was devised. The iron basket was made for supporting glowing coals or burning fagots. Two centuries ago in England streets were illuminated in this manner. Some of these primitive light sources are shown in Figs. 17 and 18. It is interesting to recall that they are used even today on the frontiers and that they were the lights of civilization not very long ago. Many persons living recall that they or their parents read by the light of the fireplace (possibly augmented by a candle) in their early years. This emphasizes the fact that the present is the age of adequate artificial light. It has barely dawned after 6,000 years of historic civilization and more than 2,000 years after the classic architecture of Greece. The recency of the advent of radically improved artificial light is the reason for unfamiliarity with the potentiality of modern light.

EGYPTIAN

(4000 to 300 B.C.)

A fairly well-organized civilization was flourishing along the banks of the Nile at about 4000 B.C. Thus Egypt is considered to be the birthplace of historic civilization. It is true that ancient Assyria and Babylonia enjoyed a relatively advanced civilization even before this, but we are not so familiar with it. The Egyptians led an orderly life in a more or less arid land of perpetual sunshine. Timber was scarce, so their structures were made of stone. Slave labor was cheap, and monumental edifices were constructed. Only under such conditions could the pyramids have been built. It is fortunate that stone was the material widely used for monuments and buildings, for we owe to its durability our knowledge of the life of that far-off period. Archeologists have read that early history of mankind from the hieroglyphics, ornament, implements, architecture, and other fingerprints of the early Egyptians.

One of the first impulses of civilized man was to improve upon animal skins for clothing. The weaving of textiles was flourishing in 3000 B.C. Rather fine textiles which were made more than 3,500 years ago have been found in the tombs of kings. The ancient Egyptians were skilled in glass blowing, metal cast-

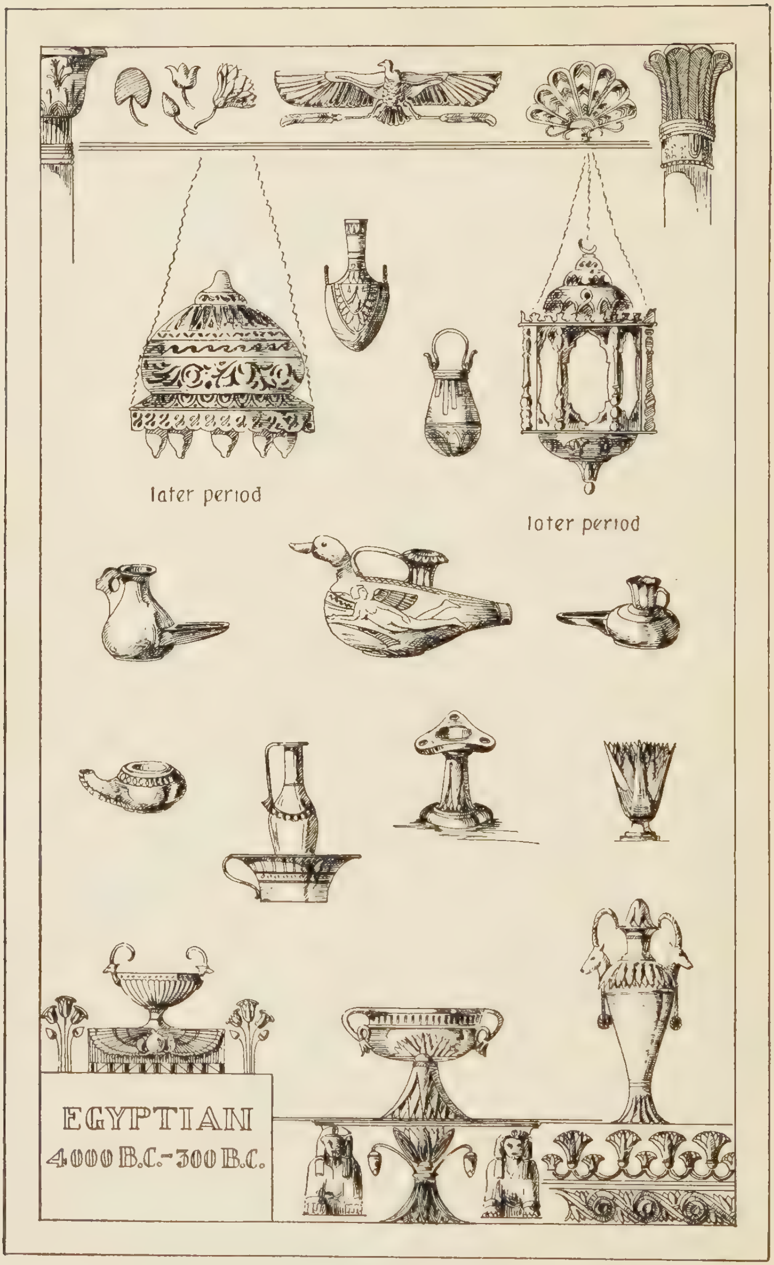

Fig. 19.

ing, and pottery making. Their carving was usually sunken rather than in relief.

Colors were used in the greatest purity in which they were found in Nature and were also used more or less subdued in moderate shades. Only a relatively few coloring media were available, but these were used in striking combinations. Gold, red, yellow, blue, white, and black were commonly employed. Some combinations were red, white, and blue; red, yellow, and black; red, yellow, and blue; blue, white, and black. Painted friezes were common on walls and much colored ornament was applied to columns.

In their ornament the Egyptians more or less conventionalized several plants which grew in abundance, besides utilizing geometrical design quite extensively. The lotus bud and flower is the most common plant motif. It was used in friezes and very conspicuously for capitals of columns, as seen in Fig. 19. The papyrus flower was also commonly employed. Both these plant motifs were used for ornamentation very widely, from the smallest to the largest objects. Among other ornaments were adaptations of the lily, papyrus reeds, the beetle, the cobra, and the human figure. The Egyptians worshipped the sun; hence, the winged disk in their decoration. They respected the Nile which watered their arid land. Perhaps the zigzag onaments are suggestive of rivers. They copied various animals, including the ram, lion, ibis, and hawk.

The light sources of Egypt were the oil lamps of clay, stone, and metal, and to some extent the torch.

The proximity of the Egyptians and the Assyrians caused their civilizations to intermingle, with the result that their art is similar. However, other reasons must be sought for explaining the similarity between the Aztec designs and those of Egypt located on the other side of the earth.

Rarely do we encounter the use of the Egyptian period in architecture at the present time, although it has applications in distinctive shops, restaurants, candy shops, etc., because it is strikingly different and may be highly colorful. Modern lighting effects may be obtained from fixtures ornamented properly or in a more realistic manner by concealing the lighting equipment in vases, in large replicas of the clay oil lamp, and in various suitable architectural ornaments. In such an interior the possibilities of colored light may be utilized. Certain symbolisms of light and color are appropriate. The sun may be imitated with artificial light. Some Egyptian structures seem to suggest, by the lotus capitals of columns supporting a ceiling in blue color, giant flowers growing under the open sky (see Figs. 19 and 20). By illuminating the ceiling with bluish light from concealed light sources, such an effect may be emphasized. Certainly, modern lighting and decorative facilities can reproduce the most colorful and golden splendor which the kings of Egypt enjoyed.

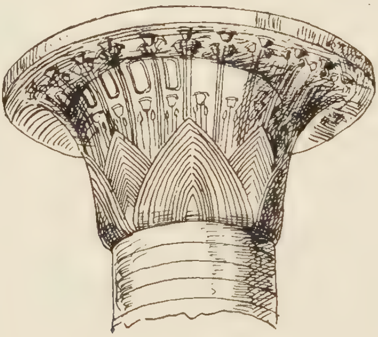

Fig. 20.—Egyptian capital.

ASSYRIAN

(2300 to 600 B.C.)

In Mesopotamia along the Euphrates and the Tigris rivers, a civilization developed similar and contemporary with that of Ancient Egypt. This old Babylonian civilization existed in 4000 B.C. Great structures were built and ornamented more or less like those of Egypt. Babylonian civilization exerted an influence in Persia and in the Far East. The buildings were constructed of sun-dried bricks faced with stone or plaster.

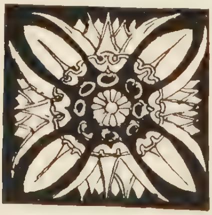

Fig. 21.—Babylonian or Assyrian.

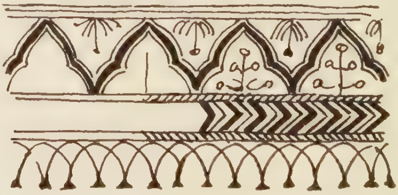

Fig. 22.—Persian.

Owing to the lack of durability, few remains exist at the present time. The Assyrian period includes the Chaldean 2300 to 1300 B.C. and ends with the late Babylonian about 600 B.C. Assyrians and Babylonians intermingled in warfare and in commerce.

Gold, silver, and brilliant colors (red, green, blue, black) were conspicuous in ornamentation. Wood carvings and bronze work were introduced in the later part of the period. The date, vine, fig tree, lotus flower, palm, lily, fern, winged bulls, eagle-headed lions, human figures with wings and with eagle heads supplied motifs from decoration (see Fig. 21).

The Persian Empire existed from 558 to 330 B.C. and at the time was very powerful. Its art is the last from Mesopotamia. When the empire was conquered by Alexander the Great, the Hellenic art influence set in and also conquered the art which it invaded (see Fig. 22).

The art of the Hebrews was somewhat restricted by the Mosaic law, but it attained creditable heights in 1000 B.C. The Phoenicians were too engrossed in trade to develop a noteworthy art.

INDIAN

It is likely that the civilization of India is of very remote origin, but little is known of it before 1000 B.C. India is a large region, which has been occupied by various races of people differing greatly in character and culture and, therefore, in art. Indian art was influenced by Persian and later by Greek art. The early Brahman period may be considered to have extended until about 250 B.C. Then the period of Buddha began, and ended about 700 A.D., when the Brahman religion was reestablished, which was to continue until 1200 A.D. The art was quite fantastic and highly ornamental. Finally, the Mohammedans came and brought with them their art. India broke away from

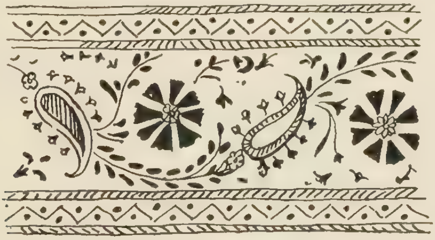

FIG. 23.—Indian.

the Koran in the sixteenth century, but the art of India as we know it is Mohammedan. Its ornament in recent centuries includes the lion, tiger, peacock, elephant, human figure, and elaborate floral design (see Fig. 23).

What we know of Indian, Chinese, and Japanese art is of comparatively recent date. Therefore, these periods might logically appear in later chapters. However, there seems to be no other place more suitable than the present one for introducing them. Certainly, they began in remote times and, owing to our greatly different civilization, we have a feeling of remoteness toward these Oriental arts. Their influences on later periods are touched upon in the treatment of those periods.

CHINESE AND JAPANESE

Chinese civilization is known to have extended to a remote period, but, as with India, little is known of its early art. It is generally believed that a highly developed art existed long before the earliest records which are available. The capital, which is prominent in the decoration of all other periods, does not exist in Chinese and Japanese architecture. The pagoda is a well-known structure. It was built of wood in early periods and later of brick and tile. The Chinese were masters of porcelain, terra cotta, bronze, embroidery, and carved wood (see Fig. 24). Their works are highly ornamented—in fact, they are overloaded with ornament. The earliest examples of Chinese architectural ornament in existence date from about 1200 A.D.

Japanese art originated in China, but it is quite distinct from Chinese. It is less conventional and more of its motifs are adaptations from Nature. Like the Chinese, their work is elaborately ornamented. The oldest Japanese art available dates from the advent of the Buddha religion in about 600 A.D. The Japanese lacquer, metal work, and painting possess high standing as art (see Fig. 25).

Both Chinese and Japanese art have exerted definite influences in certain periods of western civilization. Their effect is seen in the late Louis XIV, when this period became frivolous and extravagant. In 1720, Louis XV attempted to establish commercial relations with China by sending gifts to the Emperor. The latter reciprocated with many rare Chinese gifts, with the result that the Chinese style became quite the vogue for a time in France. Such Chinese ornaments as dragons, birds, pagodas, and

Chinese scenery were incorporated in French works. Lacquer work was also introduced and copied.

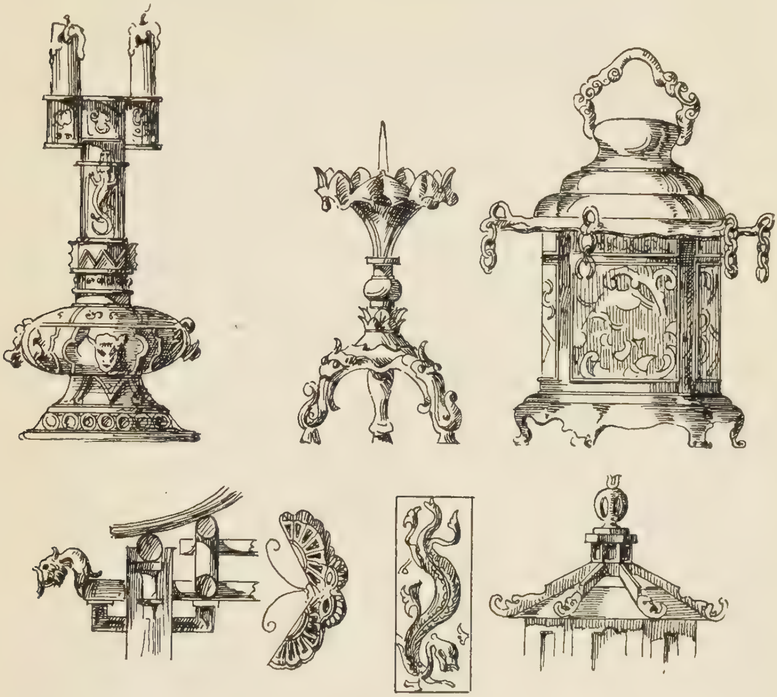

Fig. 24.—Chinese.

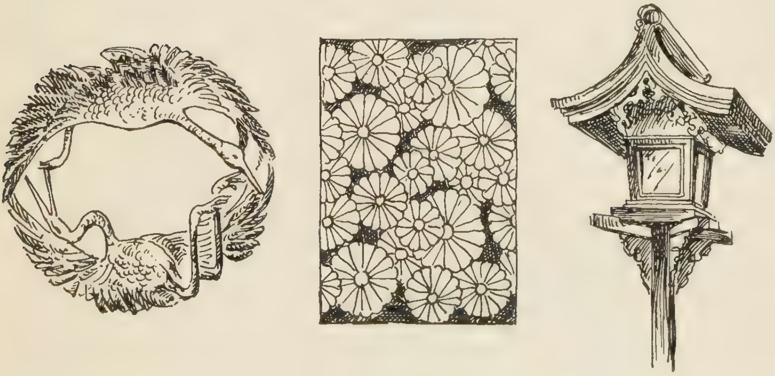

Fig. 25.—Japanese.

Chinese porcelains and landscapes in lacquer were introduced in England in the late Stuart period. In the Georgian period, Chinese wall papers were imported. These designs included birds, flowers, landscapes, and more or less characteristic conventional Chinese scenes. At this time the fad for Chinese art prevailed in furnishing and decoration. Later, Chippendale used Chinese motifs quite extensively. In 1624 Japan closed its door to all foreigners and kept them closed for 250 years. This fact accounts for Chinese art having full sway wherever the art of the Far East was desired in France, England, and other western countries.

Chinese art is extravagant and full of symbolisms. Deities and demons are common. The Japanese perhaps have a greater talent and a better taste for details. Japanese art employs butterflies, dragons, peacock feathers, flowers, waves, and a multitude of Nature's details (see Figs. 82 and 153).

CHAPTER X

THE CLASSICAL AGE

While civilizations in Egypt and Mesopotamia were slowly advancing and receding under the restrictions of traditions, the Hellenic peoples were establishing a culture which was destined to be the beginning of a western course of that civilization which was to reach the greatest heights. Greece consisted of a group of rival states which were bound together by race, religion, and language. Notwithstanding this rivalry, which often resulted in war, the Greeks were bound together in one fundamental culture. To them the remainder of the world was barbarian. They possessed the attitude of inquiry, which is a primary essential for progress and supremacy. They were idealists of refined tastes and of artistic restraint.

The Romans were bound together in a single political state, but within this there were many races, religions, and languages. For the development of high ideals and a great art, the Greek condition was more favorable than that of the Romans. What the Romans lacked in artistic ability as compared with the Greeks was counterbalanced by their superior ability for administration. Their conquests enriched them and developed a desire for splendor. They took the art of foreign countries and built with it, although their architecture and decoration eventually acquired a Roman character. They borrowed from the Etruscans until their conquest of Greece introduced the refined Greek art into the Roman Empire.

This Classical Age of artistic glory and splendor has been the greatest source of inspiration throughout the centuries which followed its decline. The history of art is a fairly comprehensive history of civilization. The early struggles of a people give them character with which to produce their art. They progress upward, but seemingly they cannot continue ever upward. Their very progress is their undoing, for splendor and prosperity weaken their character and the inevitable decline sets in. They have reached their greatest height. Rise and fall seem to be the rule. The rise seems to be a certain prophecy of inevitable fall. Surely, nations and men are far from perfection when their progress is the cause of their failure.

Posterity certainly benefits by the rise and possibly sometimes by the fall. At any rate, we may well be thankful that the art of Greece is available, for in our altered life it is unlikely that such refinement and pure ornament as is found during Grecian prosperity could be developed in this scientific age.

GRECIAN

(2000 to 146 B.C.)

The art of the Hellenes was always progressive from the earliest periods. This is a legacy of their idealistic and inquiring attitudes. It shows refinement, restraint, and a degree of perfection which greatly surpassed any preceding art and which in many respects has never been excelled in later peiods. The earliest Greek ornament naturally shows Egyptian and Assyrian influences. This indicates that there was more or less intercourse among these nations. In the absence of other historical records the fragments of architecture and other works of man shed light through their ornament in an otherwise historical darkness. The severity of Egyptian ornament yielded to the more refined sense of the Greeks and became more pleasing. Artistic style is a certain index of character intellect, whether it be a person or a nation.

The Mythical period of Grecian art extended until about the year 1000 B.C. The Aryans are supposed to have been the original inhabitants of Greece. A definite national Hellenic art did not begin until about 1000 B.C., when a republican form of government was inaugurated. Mythology was a source of inspiration for much of this early art and perhaps was responsible for sowing the seeds of idealisms. About 700 B.C. the influence of Egyptian, Assyrian, and Oriental art declined and an original characteristic art and civilization began to develop in earnest. The first period which arose was the Doric, about 600 B.C., and this was followed closely by the Ionic period. The greatest age in Greek art began with the final victory over the Persians in 466 B.C. This may be termed the age of Pericles. After resting, as it were, for a half century, Grecian art had a brilliant revival, which ended with the Corinthian period about 300 B.C. From

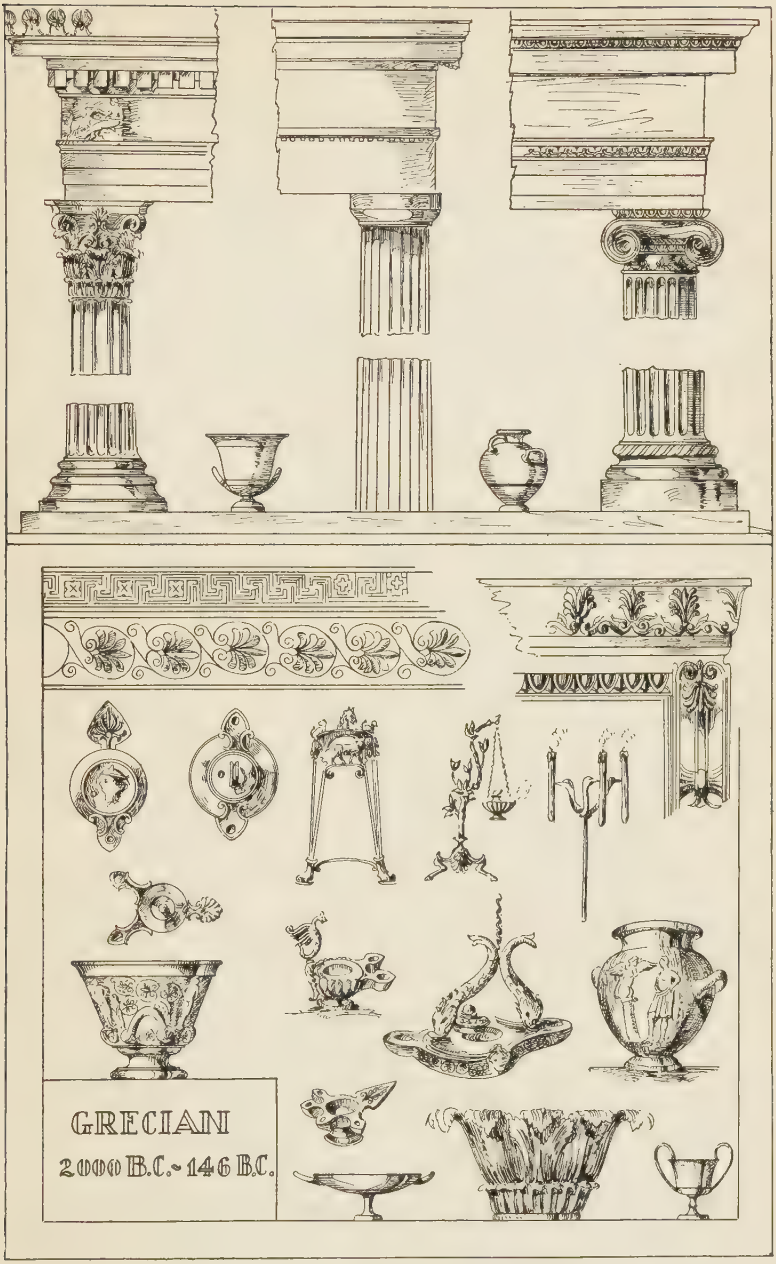

Fig. 26.

then on there was a decline until the Roman conquest in 146 B.C., but this decline was not without wonderful art. The Greek artists continued to create for their conquerers and greatly influenced Roman taste and art (see Fig. 26).

The Greeks possessed a keen sense of beauty in form and, as a consequence, color is not as conspicuous as molded forms in which light and shade are the primary vehicles of expression. They did not confine their attention to the ornament without relation to the object, for they seemed to have in mind always the importance of this relation. They searched for perfection of form in its fullest sense. They had the true esthetic sense which told them how to use ornament. They knew also how to restrain its use—when surfaces should be plain and how far to elaborate the ornament itself. These are some of the reasons why Grecian decorative art possesses a noteworthy distinction among all other styles. Much of the Greek style was based upon wooden structures and many of the structural forms were later modeled in stone.

The decorative motifs which they employed extended over a great range, including natural forms, geometrical designs, and conventionalized forms. The lotus bud and blossom, the palmette, and the so-called egg-and-dart motifs doubtless came from Egyptian art. Among other natural forms which were employed are the vine and the acanthus leaf; festoons of flowers and fruit; human heads and masks; animal heads, wings and feet. Geometrical forms included the fret, wave, circle, scroll, spiral, rosette, and reversed curve. They used moldings, flutings, dentils, and decorative capitals. Their architectural ornament was largely carved and color was incidental. Their pottery was painted, and color was a prominent feature. They combined relatively few forms in great variety and this variety is so extensive that an exact duplication of ornament on different objects is rare.

It may be emphasized again that the Greeks strove for perfection of pure form and in this respect they have not been surpassed. The best Greek ornamentations on moldings, for example, imitate nothing. They are abstract forms. The egg-and-dart is so well adapted to the molding section that a curve quite similar to that of the section is seen from various viewpoints. Although many of their motifs were taken from familiar things, they worked over them with such care that they developed much pure form perfectly adapted to the uses they made of these ornaments.

Color was used extensively on frescoes and in pottery. In fact, notwithstanding their dominant liking for form, their appreciation of color is evidenced by their use of strong color. They commonly used red, yellow, blue, and purple. Their early pottery had a red tint, with black and brown decorations. Later, their vases were often orange, with black decoration. Grecian pottery was notable for its beauty of form and coloring.

In the Doric style, massive columns with shallow channels cut longitudinally on their surfaces were set upon the stylobate, or supporting floor. The column had no base, but was surmounted by a simple capital. The entablature borne by the columns was simple, usually consisting of a plain architrave, a frieze divided into rectangular panels by triglyphs, and a simple overhanging cornice. A triangular pediment covered with sculptured ornament filled gables of low pitch. This style reached its height in the Parthenon about 440 B.C. It was the most common style used in the temples in European Greece and southern Italy.

The Ionic style was introduced a century or so after the Doric appeared, and became the dominant style in Asiatic Greece. It is more delicate than its predecessor and is quite suggestive of its wooden ancestors. The fluted columns are less massive than those of Doric style and they stand on molded bases. The capitals which surmount them are characterized by ornamental spiral volutes connected by a horizontal band. The architecture is banded; the frieze is unbroken; the cornice is often decorated with dentils. As this style developed, carved ornament became richer and more varied.

Eventually, from this style emerged the Corinthian, with its still more slender columns. Its capital was decorated with acanthus leaves underneath coupled volutes which support the corners of a molded crowning cap. At this time carved ornament was employed very extensively. The Corinthian style became more and more complex and varied, especially in Roman art.

The acanthus is a common plant in Italy and Greece and it became a prominent motif in Grecian art about 400 B.C. As carved ornament developed, the acanthus leaf motif became more elaborate.

Daylight was admitted to Grecian temples through the doorways and sometimes through openings in the roof and through clearstory windows. The artificial light source was chiefly the oil lamp of stone, clay, or metal. In these shadowy interiors an air of mystery must have been associated with the recesses arousing various fancies in the imaginations of the artistic people, to whom mythology was full of living characters and vivid episodes. But the Grecian interior was so beautiful that reproductions in the present age may well demand diffused light, adequate but not harsh, in order that their beauty may be fully revealed. Surely, the Greeks would have availed themselves of adequate lighting from concealed sources, from chandeliers, etc., to enjoy the more the beautiful works which they had wrought if they had had light-sources like our modern ones. Little can be done to adapt the lighting equipment of the Grecian period to modern light sources. However, we may clothe our modern equipment with the forms and ornamentation characteristic of that period and avail ourselves of the opportunities afforded by architectural details, vases, and other furnishings for concealing our modern equipment.

ROMAN

(450 B.C. to 450 A.D.)

The Roman Empire consisted of a number of races, possessing different religions and languages, but these were welded into one political state by the Roman genius for organization. As the Romans extended their conquests, their prosperity increased, so that eventually they developed much pomp and splendor. But they conquered with politics and armies and borrowed much of their art. It may be said that the art of the Greeks conquered the Romans. The latter were practical, as is seen in the construction of their great buildings, and they adapted and combined the art which they borrowed. They developed architecture and sculpture very highly, but their love of luxury and splendor overburdened some of the Greek forms of exquisite simplicity. They developed mosaic art from the Orient to a high state.

The Etruscan people settled in the region known as Tuscany in about 1000 B.C. They developed an art which was quite creditable about 600 B.C. It shows a Grecian influence, notwithstanding the fact the Etruscans were apparently quite unlike the Greeks racially. They were conquered by the Romans about 350 B.C. and became a source of supply of art for the Romans until the latter conquered the Greeks. The fall of the

Roman Empire in the fifth century marked the decline of classic art. The Christian barbarians had no taste for the highly developed art of that time. The Eastern Roman Empire, which was Christian, was a dominant influence in the Christian states which sprang from the ruins of the Western Roman Empire. The early Christian and Byzantine art exerted such an influence that the Romanesque style sprang up a few centuries after the fall of classic art (see Fig. 27).

The Etruscans were skilled in pottery, terra-cotta ornamentation, bronze casting, sheet-metal work, jewelry, filigree, and modeled relief. The skill of the Greeks has already been discussed. These were the sources of art which the Romans utilized in new structures. They devised new structural methods, employing combinations of brick, cement, concrete, and other materials which were new. The arch and the vault afforded new architectural opportunities. The crude materials which they used required facings and, as a consequence, stucco, mosaic, and marble veneer were developed along with much ornamentation in relief. They added sculptured human figures in groups in pediments and reliefs in panels. They introduced color effects by combinations of colored marbles and granites. Their mural paintings were of brilliant colors and they added bronze grills and decorative elements of furnishing, such as candelabra. With hordes of men to labor, with much wealth, and with much art to draw from, their works were numerous, varied, monumental, and extensive in grouping (see Fig. 28).

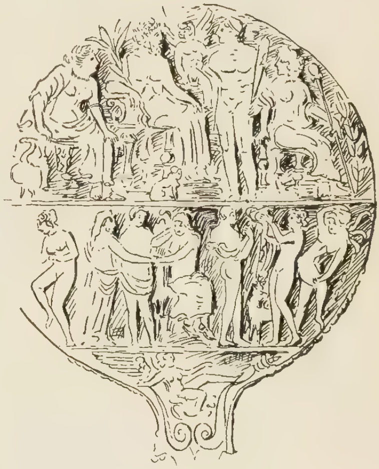
Fig. 27.—Etruscan.

They developed plastic art to a high state. They extensively elaborated the Corinthian style. Their natural motifs included the pineapple, vine, poppy, palm, acanthus. They used the lion head and the eagle, signifying triumph, winged horses, and dolphins, and created many monsters. Notwithstanding the profuse ornamentation and variety of architectural forms which

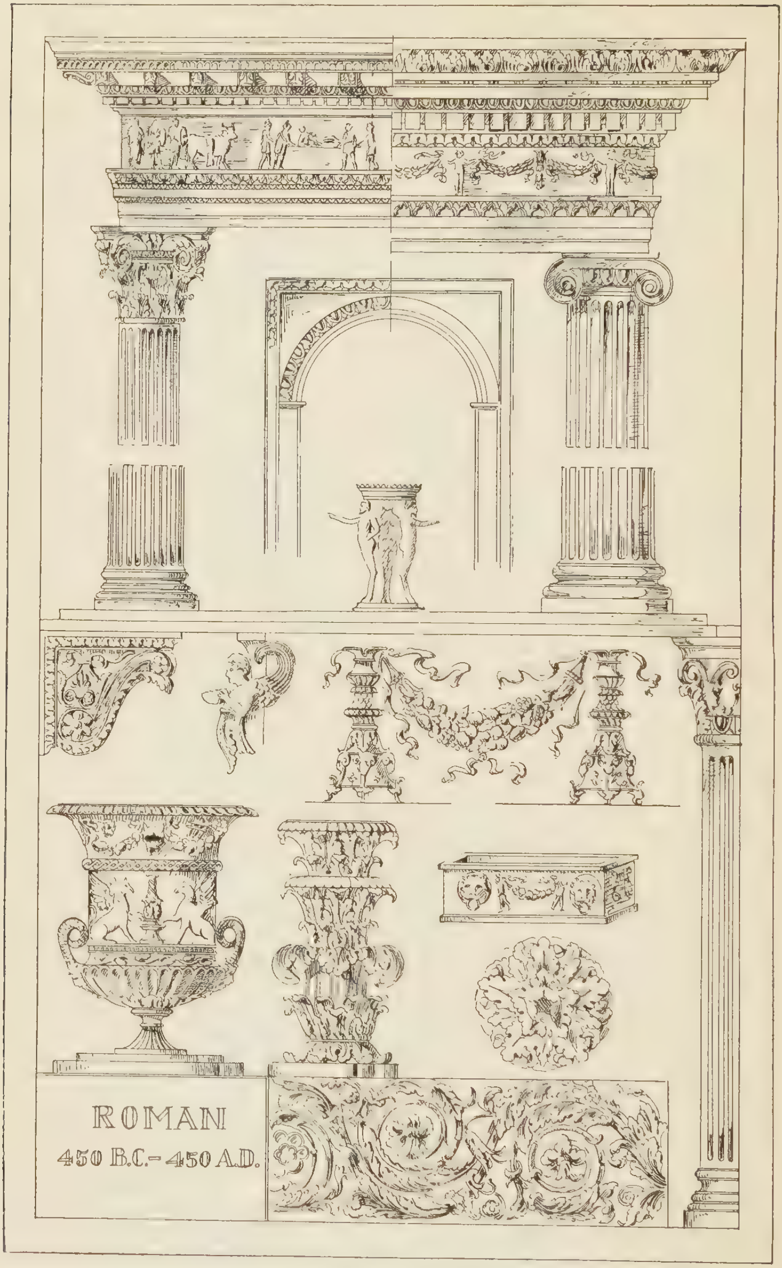

FIG. 28.

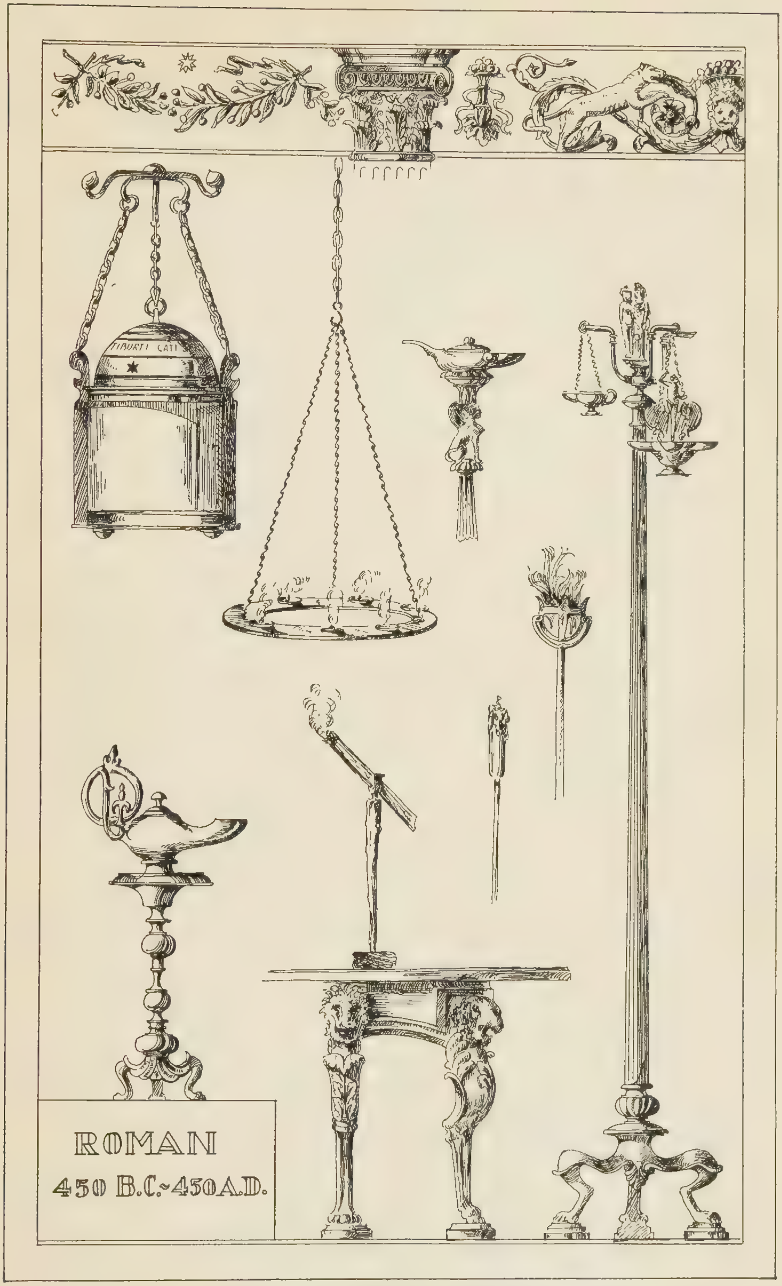

Fig. 29.

they combined, their works usually possessed dignity with magnificence.

Their lighting devices consisted of the oil lamp and candelabra (see Fig. 29). The lighting of modern reproductions of Roman styles presents the same problems as those of Grecian styles. However, the ornateness and the variety in Roman style makes it less difficult to reconcile new devices and their places of concealment than do the Grecian interiors of simple harmony and quiet dignity. With the conquest of Greece, Grecian art did not actually cease. It was transferred to Roman mastery when Greek artists served the Romans. In this way it did much to keep Roman art refined. Without its influence it seems reasonable to conjecture that the practical Roman, loving pomp and splendor, would have run far afield in art. Here was an excellent combination for the great achievements of the period of the Roman dominance.

POMPEIAN

(100 B.C. to 79 A.D.)

Greek and Roman ornament are found at their best combined in the buildings of Pompeii and colorfulness is a dominating characteristic. This prosperous city stood, along with Herculaneum and Stabia, on the bay of Naples until it was completely buried by an eruption of Mount Vesuvius in 79 A.D. Under its coating of ashes its ruins lay concealed for about seventeen centuries, until it was accidentally discovered in 1748. Artists flocked to see the ancient ruins and went away inspired with classic art. The influences of this new inspiration is to be seen in the art of the late Georgian period, for the Adam brothers were among those who saw and were conquered.

The city of Pompeii was subjected by the Romans nearly four centuries B.C. and became a summer residence of wealthy Romans. Greek artists were imported, Roman art was added, and a Pompeian style eventually arose. Among the chief characteristics of its art are the colorful paintings on the walls and the colored stucco ornamentation. Architectural pictures in perspective were painted on the walls. Varicolored marble was imitated by painting areas of the walls divided into panels. Brilliant colors were skilfully used, so that the integral effect was pleasing and even soothing. Mosaic art was common, particularly for floors. Sometimes the colored marble, stones, and tile were so arranged in patterns as to suggest familiar rug designs. Mosaic pictures of fine quality were produced with a variety of subjects. This treatment of floors and walls was practiced in private dwellings as well as in public buildings.

The wall spaces were divided into a dado, a middle, and an upper section. The dado was often black, with simple ornamentation. The middle space was commonly painted green, blue, violet, or purple with landscapes or figures painted upon it. The upper space or frieze was commonly white. The scenic paintings were of a variety of subjects, such as palaces, rural scenes, mountains, seascapes, warfare, gods, heroes, commerce.

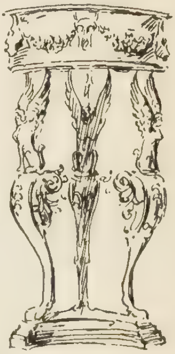
Fig. 30.—Pompeian tripod.

A great many utensils and furnishings were preserved in the volcanic ashes, so that now they may be seen in the museums. Fountains, marble vases, marble tables, candelabra and tripods of bronze, mirrors, lamps, and even ironwork are among the relics to be seen (see Fig. 30). Greek refinement appears in all the details of Pompeian art. The fluted standards of tripods and candelabra are slender and graceful compared with the massive splendor of similar Roman relics. Among the ornaments are delicate garlands, masks, fruits, animals, lions' paws ending in the heads of human beings or of beasts.

CHAPTER XI

THE MIDDLE AGES

While the art of the Greeks and the Romans was attaining its magnificent heights, another style was developing in the Byzantine Empire to the eastward. Christianity was struggling for existence, but it could not develop openly in Imperial Rome. Art of early periods was usually closely associated with religion. This was quite natural. Religion molded the ideas and the character of human beings. It furnished many themes and symbolisms. It required buildings and devices for its ceremonies, and into these structures and their decoration went the work of devotion. The Early Christian art (Fig. 31) began to flourish in the Eastern Roman Empire when Constantine legalized Christianity in 312 A.D. Here it was influenced by Byzantine art, which was already flourishing. After the edict of Constantine Christian artists in the Western Roman Empire came out of the catacombs of Rome and began to develop their art. But they were essentially Roman artists. In 455 the Goths from northern Europe attacked Rome and wrought great havoc. Constantine fled to the Byzantium, formerly a Grecian city and at that time the headquarters of the Eastern Roman Empire. Rome became the center of Christianity. The Roman artists introduced the symbolism of a new religious art. This was the beginning of the Dark Ages for western civilization. Relatively slow progress was made in this civilization for many centuries. In the East, Byzantine art flourished, but in the West the con-

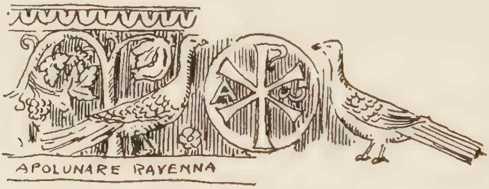

FIG. 31.—Early Christian.

querers apparently did not know how to utilize skilfully the art which they inherited from the Classical Age.

Celtic art (Fig. 32) had been developing in the North since 2000 B.C., but the Celtic nation was driven out of western Europe before the Christian era. They settled in Hibernia, which is now Ireland. Their art was pagan until about 400 A.D. Later the Romanesque influence became prominent. The curved lines and exaggerated bird forms were replaced by the floral designs.

Scandinavia was pagan until about 1000 A.D. Its ornament was a confusion of lines, and various animals and human figures were prominent. The Celtic missionaries brought the Christian religion into the country and with it came ornament of Roman character. Thus realistic plant life was introduced into their art.

Those living north of the Gallic country were first termed Norsemen and finally Normans. Their art was Scandinavian. They settled in Normandy in about 900 A.D. and conquered England in 1066. They brought with them an art influenced by Romanesque as modified in France.

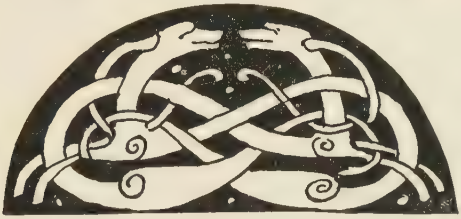

FIG. 32.—Celtic.

Russia was settled by the Scandinavians in 862 A.D. Until about 1100, Russian art was greatly influenced by religious fervor, but after that Oriental influence became prominent.

The art of the Middle Ages was chiefly associated with the church, the monastery, and the castle. These structures grew into vast monuments characteristic of the period and of their use. The architecture of the church was influenced by ecclesiastical ideas and symbolisms. The monastic structures were suited to the needs of their self-supporting communities and were oases of civilization in the midst of barbarism. The castle was the home and the fortress of the chieftain and his armies. There were two primary occupations, religion and war. It was not a period of leisure and it does not seem to have been one conducive to study and reflection. Certainly, it was not a period of wealth and luxury. Still, without these encouragements for artistic development the Middle Ages were an artistic epoch. Religion and war are sources of inspiration for expression in art. The medieval era inherited the technical processes and the classic art of Greece and Rome. It needed only that great incentive—religious fervor—to arouse the enthusiasm which gained momentum until finally it spent itself in constructing the marvelous Gothic cathedrals.

The Middle Ages inherited the Grecian and Roman oil lamps which in the Classical Age usually rested on tripods (see Fig. 29). Later, more of them were suspended. Although candles were used before the Christian era, they did not come into extensive use until the Middle Ages. It is likely that their symbolic uses in Christian liturgy had much to do with their more extensive use after the impetus given to Christian enthusiasm by the edict of Constantine and the fall of Rome. At any rate, during the Middle Ages the chandelier evolved from the earlier suspended lamp. The light sources were oil lamps and candles suspended in the same plane. During the latter part of this period, candles were almost exclusively used in the chandeliers, but their use in tiers did not develop until the Renaissance.

The myriad of dancing flames on the chandeliers and altars of the church was inadequate to provide illumination of present standards; nevertheless, this shadowy lighting from many sources of low brightness is characteristic of the cathedral. In the shadows of its vaults and recesses mystery lurked. Doubtless, imagination peopled them with God, saints, and other spirits. These cathedrals seem to have been inspired by the arching branches of majestic trees in the forest. The dim solitude of Nature's leafy cathedrals was reproduced in these works of man. At the present time we can do much more with light in such edifices, but for the religious ceremony we cannot do better than retain the charm and mystery of shadowy lighting emphasized by those jewels—stained-glass windows. In the home and elsewhere the feeble lights of the period were inadequate. Certainly, they could be improved upon very much. In modern reproductions we may retain the ornament and even simulate the light source to some extent. However, we may also diffuse enough light from concealed sources to make those interiors in keeping with our present enlightenment without driving out the spirit of medievalism (see Figs. 118, 120, and 126). Outdoors at night there was occasionally a blazing torch, but there was no street lighting in the modern sense. Such lighting was born only about a century ago. These centuries were the Dark Ages in more than one respect.

BYZANTINE

(300 to 1000 A.D.)

After this art had been developing for some time, the Christian influence was introduced, when Christianity became the religion of the State. This influence endured from 312 to about 500 A.D. Early Christian art elsewhere was strongly influenced by classic and Byzantine. When this was finally achieved, the Romanesque style became defined in the West. With the fall of Rome, the Byzantine Empire became the leading civilization. The Greeks of this region borrowed from Classic and Oriental arts and very rapidly developed an Early Christian Byzantine art of much beauty and originality. The brilliant colors and surface ornaments of the Orient enriched the Greek and Roman developments of architecture and highly developed art forms.

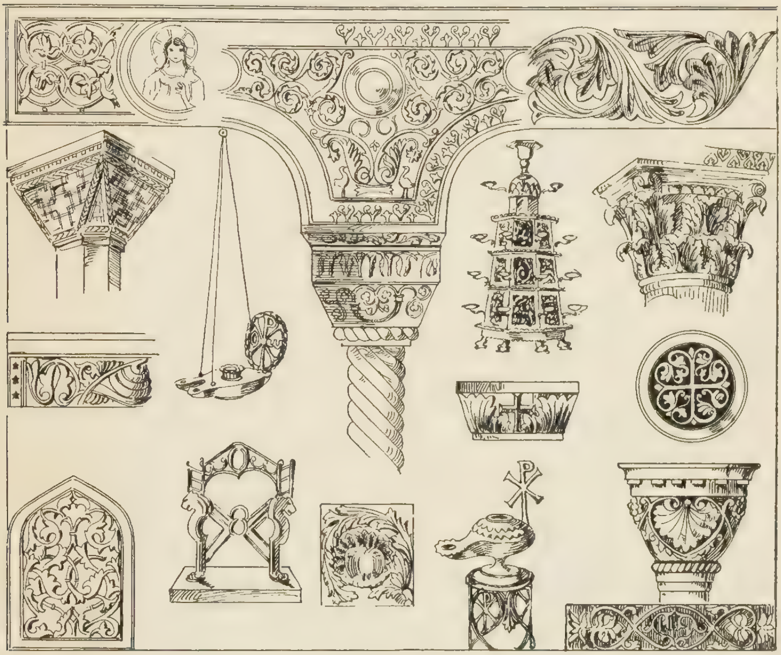

Fig. 33.—Byzantine.

This art spread into Italy and its influence was felt throughout Europe. It began to decline slowly after the death of Justinian in 565. From this time until about 800 Oriental splendor was very prominent in Byzantine art. During this time the Saracens carried Mohammedan art throughout Persia, Palestine, and Egypt and into Italy and Spain. After this period of decline it was vitalized by the influence of Macedonian art. This is the classic period of Byzantium. The Byzantine style (Fig. 33) affected all Romanesque styles and even when Constantinople was conquered by the Turks it became the art of their mosques to a great extent.

The Byzantine artists substituted for the Roman carved ornament a decoration in color upon unbroken surfaces. In other words, they strove to eliminate depressed and projected ornament to a great extent. Marble inlays and gorgeous mosaics covered the vaults and floors of their structures. Columns were of polished granite, marble, and other stone. Lace-like carvings and arabesque patterns in fresco were employed; however, high relief and figure sculpture were not common. Borders and friezes were ornamented with the fret and vine modified from classic art. They altered the acanthus leaf almost beyond recognition. The Christian influence introduced the cross. The cypress tree symbolized the grave and the peacock was a symbol of the soul.

The Byzantines were extravagant in the creation of decorative forms. They employed the griffin, unicorn, tiger, elephant, eagle, flowers, palms, apples, and trees. Their textiles were decorated with wheels, circular bands, stripes, beasts, birds, and geometrical patterns, such as squares, hexagons, octagons, and circles. These motifs were also used in their mosaics, in which they represented various architectural subjects. They employed color profusely and also pictures on colored backgrounds, which were sometimes of blue and of gold. As a whole, it was a very ornamental style, but carvings were not as prominent as decorated surfaces, which were more or less free of relief. The carvings were often of delicate pierced work or of lace-like character.

MOHAMMEDAN

(600 to 1500 A.D.)

Mohammed, who was born in 571 A.D., established his religion in 622. It was inevitable that an art style should spring up and be carried along by this new religious influence. As the Islamic faith progressed through Persia, Syria, Egypt, Spain, and Italy, it transformed the ancient and classic art which it found there. The Mohammedan style naturally varied in the different

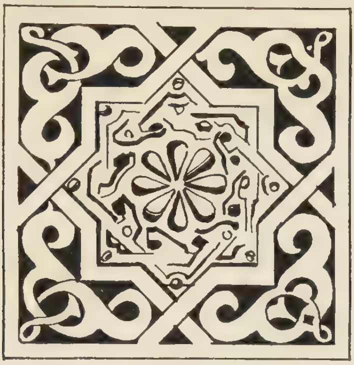

FIG. 34.—Moorish.

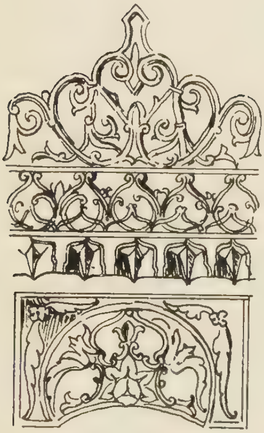

FIG. 35.—Ottoman.

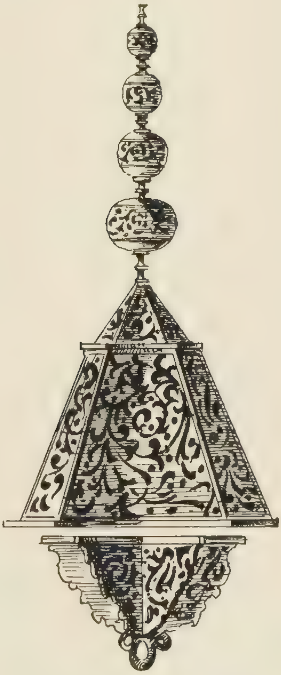

FIG. 36.—Mohammedan mosque lamp.

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countries because of climate, materials, workmen, and the native art which it permeated or absorbed. The naturalistic representation of men, animals, and flora was prohibited and therefore, conventionalized natural objects and geometrical designs of great variety were utilized in ornament along with Arabic characters. The lace-like ornamentation is profuse and exquisite.

The Mohammedan style in Syria and Egypt is known as Saracenic (Fig. 34) and dates from about 634, when the Saracens conquered these countries. In Spain, Tunis, and Morocco it is known as Moorish. The Saracens conquered Byzantium and northern Africa in 700 and entered Spain in 711. In Turkey it is known as Ottoman (Fig. 35). The Turks conquered Asiatic Byzantium and Constantinople in 1453. The pointed arch was used in the mosques and became an emblem of Mohammedan faith. In northern Africa and Spain the horseshoe arch prevailed. The Moors introduced the cusped arch. The earlier ornament was an interlacement of flat geometric and plant forms which were not realistic. The early Moorish was quite like the Arabian, but later evolved into the Alhambric of more elaborate ornamentation. The later styles developed a more floriated form, which in the Persian reached its highest development in 1500. The Ottoman style was Arabian with Byzantine influence, often characterized by a conventional pea vine and pod and sometimes by the introduction of animal motifs.

The Mohammedan style as such is of little importance to western civilization except as an artistic source and influence. It is related to Byzantine just as is Oriental art. It is essentially an Oriental style adapted and modified by the usual conditions. The mosque lamps and censers are of interest (see Fig. 36).

ROMANESQUE

(700 to 1100 A.D.)

When Byzantine art began to be influenced by the Mohammedans, the art of Europe to the westward was undergoing a transition toward the Gothic. This new style became known as the Romanesque, because it had its roots in classic Roman art. Beginning with the arts of Greece, Rome, and Byzantium, the Romanesque style evolved in various countries of western Europe. In 773 Charlemagne conquered the Lombardic kingdom and became King of Italy. He gathered together artists from Byzantium as well as from the former Western Roman Empire for the purpose of decorating his palaces. This may be considered a practical beginning of the Romanesque style, if it may be considered to have a definite beginning. It was a style based primarily upon classic art, but strongly permeated by Byzantine influence. This promising impetus died with Charlemagne, and for more than two centuries in these Dark Ages art lay dormant under incapable rulers. It revived in about 1000 and under the inspiration of the Crusades some excellent works were produced.

The early architects of this style were priests and monks. The ornament was severe and heavy, but it improved in later centuries, reaching its climax in about 1200. It spread into all countries of Europe, and through modifications due to different peoples and modes of life it became quite varied. It is the prominent art influence of the Dark Ages carrying on until the Gothic period ushered in the Great Revival. As already stated, for seven centuries after the fall of Rome chaos reigned. Famine and pestilence stalked along in the wake of war. Mohammedans invaded Sicily and Spain. Italy was overrun time after time. The northern peoples of Scandinavia and Germany spread out into older civilizations. But in this turmoil the Christian religion was gaining followers and out of the chaos the church emerged with great power. The monasteries were the havens of harassed peoples and so enjoyed high favor. The papacy wielded its powerful influence for organization. These were Dark Ages because, with the great changes due to the fall of the Roman Empire and the freedom of Christianity, civilizations had to adjust themselves.

In art there was a great difference between eastern and western Christendom. All of it was influenced by the Byzantine, but the West did not take to mosaic as the East did. Form, such as carved ornament, was more favored than the color of the East. Therefore, the Romanesque style (Fig. 37) is characterized by form rather than by color. The term Romanesque covers many variations which may be considered more or less associated but nevertheless distinct styles. However, it is beyond the scope of these chapters to present a detailed analysis. By recalling that the style sprang from classic Rome and that its chief characteristic was ornamentation by the use of form, it is not difficult to

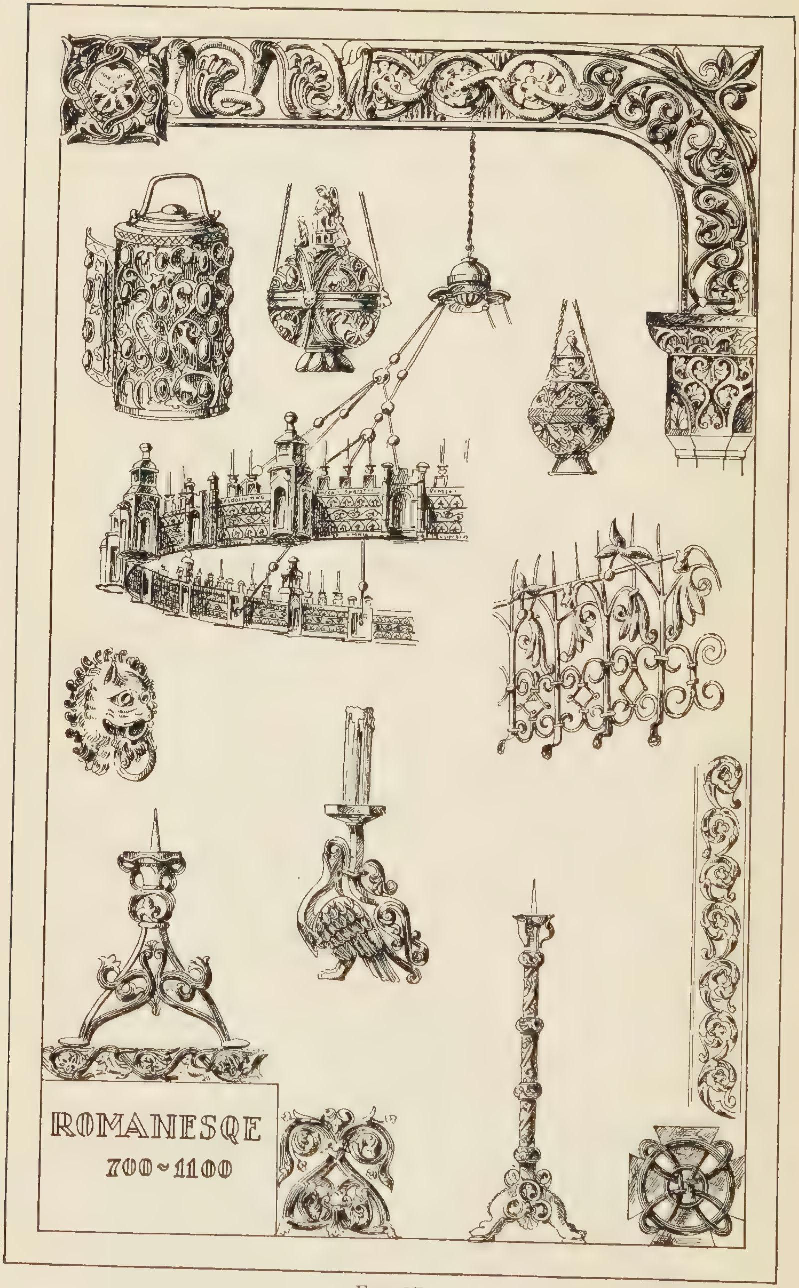

Fig. 37.

visualize the result of its permeation into the arts of very different nations. It developed eventually into the Gothic.

The arch and the vault introduced by the Romans began to play important parts in architecture in the Middle Ages and they became very characteristic in the Gothic. Stained-glass windows appear to have been introduced, at least, in the sixth century, but the earliest known to exist now were made about 1100. These Romanesque windows contain medallions with small figures and ornaments seemingly related to textile ornament of several centuries previous. In the Romanesque period there was no defined style of ornament which overspread all the phases of art expression. Mosaic, carving, textiles, and stained glass each had its own ornamental designs, the forms and coloring of which reflected their individual historical sources. In this period many fanciful forms were introduced, such as fantastic ravens along cornices, grotesque human masks, goats, snails, etc. A certain amount of inlay and enamel work was characteristic of this period in various countries of western Europe. Mosaic art persisted in Sicily and Italy and wheel windows were common. The Lombards introduced a solemnity, by rugged massiveness, into Italian art and also into other Romanesque art. This influence was characteristic of this Germanic race, which brought with it a somber humor expressed by grotesque sculptures (see Fig. 38).

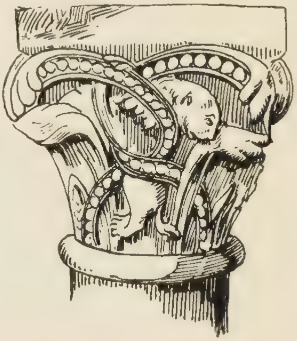

FIG. 38.—French Romanesque.

In French Romanesque the classic influence is demonstrated by the Corinthian capital, but with a heavy abacus added. Grotesques were introduced through Lombard influences. The traditions of classic art were gradually crowded out by naturalism somewhat conventionalized. Stepped arches with square edges were developed, which later were highly perfected by Gothic artists. Geometric motifs were prominent in Normandy for moldings. Common among these were checkers, nailheads, and very conventional foliage forms. However, horizontal moldings were not conspicuous forms of ornament in French Romanesque. Decorative sculpture began in this period and these works were the ancestors of the beautiful portal sculptures of the great Gothic cathedrals. Painted decoration was simple and restricted to important portions of the interiors. Some brilliant coloring of gold, red, green, and yellow was applied to columns and capitals. Ironwork, wood carving, and tiles flourished, but not of the variety and richness of contemporary Italian art.

In German Romanesque the ornamental forms were imported from France, Lombardy, and Byzantium. The early work was rather plain, but later very creditable art developed, although there is a rugged simplicity about the architecture compared with some of the highly decorative styles of this period. The Lombard influence is shown by the grotesques. Metal was worked with great skill. Iron and bronze grilles, lamps, and candelabra were common. Gold, silver, and enamel were used for the finer work. Manuscript illumination and stained glass developed to a high state toward the end of the Romanesque period in Germany. Scandinavian art was characterized by interlaced ornament, as was Celtic art. The art of England during this period was crude, and it did not develop very much until after the Norman conquest in 1066. It later became quite rich in ornament, particularly in doorways. Figure sculpture was rare, although human and animal grotesques in relief became common. Painted ornament was not in vogue. The metal work before the arrival of the Normans was crude. In fact, the English Romanesque is not important from the viewpoint of its art (see Fig. 39).

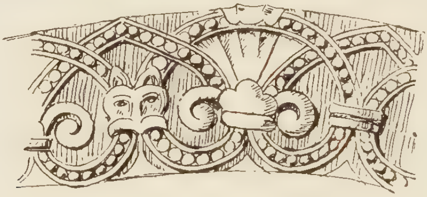

Fig. 39.—English Romanesque.

These were centuries of extreme chaos in Spain and, owing to the frequent invasions of the country, an independent style could not very well develop. In the late Romanesque period a few churches were erected free from Moorish style, due, doubtless, to the hatred of the Christians for the Moslems.

GOTHIC

(1100 to 1500 A.D.)

The Gothic style has no connection with the Goths. It evolved from the Romanesque style in northern France and spread throughout Europe. It is a result of the same intellectual development and religious enthusiasm which brought civilization safely through the Dark Ages. Its fullest development is represented in such splendid cathedrals as Chartres and Rheims. Gothic art is fundamentally architectural. Ornament was always subordinated to the form of the structural detail. It did not overrun the structure, as was often the case in certain other styles. It is dignified and even severe, but, as a whole, is very satisfying in its artistic majesty. It is an art in which the builder, the sculptor, and the carver were supreme. It was often the setting for textiles and other works of art brought from Asia, but Gothic architecture itself was a product of native artists.

Most countries borrowed the general composition and details of the Gothic style from France. Germany and Belgium copied closely and developed a Gothic style. England took inspiration from France, but developed its Gothic quite independently along its own natural lines. Spain and Portugal borrowed from France and Germany. Italy used some borrowed details, but did not develop a true Gothic style. In France, the Gothic may be divided into Early and Flamboyant with a culminating developed period between these. In England, the Lancet, the Decorated, and the Perpendicular are three divisions whose names arise from the form and tracery of the windows.

The Gothic style (Fig. 40) is centered upon the development of the vaulted cruciform church, whose central portion, or nave, received light from a clearstory. The characteristic structural details, such as vault ribbing, pointed arches, buttresses, pinnacles, clustered shafts, moldings, and tracery, were the result of the development of this type of edifice. Many of these structural details were ornamental in themselves and much of the other ornamentation symbolized and picturized the ideas of the Christian creeds. For example, the sculpture and the stained-glass windows represented incidents and ideas in the Bible, as they were interpreted by the ecclesiasts. Details, such as crockets, finials, goblets, and tabernacles, and also foliage and flowers, were used to ornament the structural forms, but seldom at the expense of the form itself. In later periods some of the structural forms were multiplied beyond actual necessity and thus became purely decorative features.

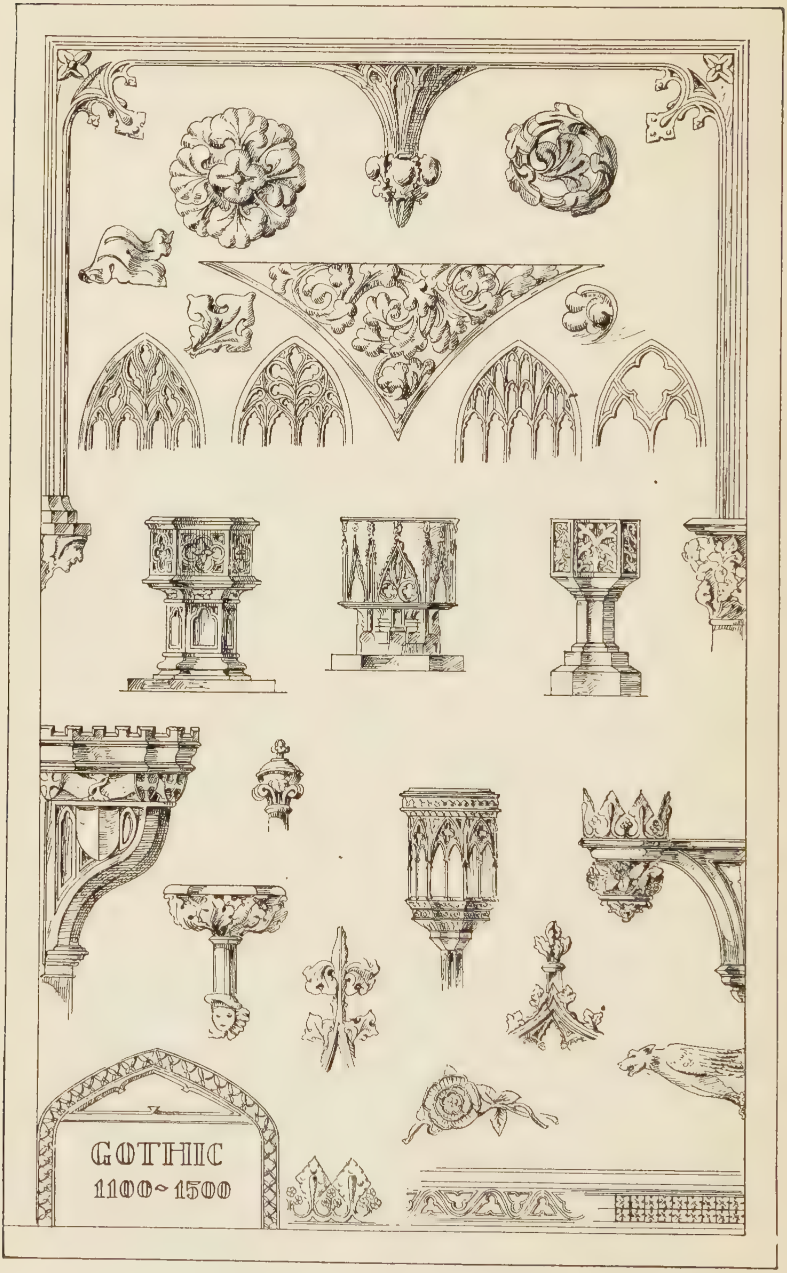

Fig. 40.

The chief ornament of this style was leaves from native plants. These were molded so differently in the various periods and countries that the character of the ornamentation is a fairly certain guide as to when and where the work was executed. At first the leaves were quite conventionalized, but this ornament gradually became more naturalistic. In early Gothic a common terminal ornament was introduced. This is known as the simple crocket. As the period progressed, this as well as other ornaments developed into a more foliated style until, finally, the Gothic style became flamboyant.

The piers consisted of clusters of slender shafts grouped around a central one and often connected with it. These shafts or groups were belted with moldings and were surmounted by foliated capitals. Corbels sometimes supported the vaulting shafts or sculpture. The capitals were evolved from the Corinthian type. The simple moldings of Romanesque and classic styles became very complex in cross-section. The vaulting is supported by ribs which were essential and decorative in themselves as is the case with many Gothic structural details. The window tracery is a prominent characteristic of this style. Single pointed arches were grouped and enclosed by an arch. In the spaces between the heads of the individual arches of the group, decorative geometrical patterns were introduced. Thus the great wheel or rose windows developed in France and the perpendicular tracery in England. Cusps were introduced and became a characteristic of Gothic tracery. Gargoyles were used for terminals of water spouts and thus paid for their decorative quality by being useful.

Figure sculpture was revived after being dormant throughout the Dark Ages. Great arches were faced with figures of saints, prophets, martyrs, and angels. Façades were adorned with them. From many imposing positions these figures looked down upon the people and provided an illustrated book quite useful in that illiterate period. Similarly, the gorgeous stained-glass windows were not only gems of light, but also pages of an illustrated book. These marvelous jewels defy mere verbal description. Wood carving reached a state of high development and provided rich ornamentation for the interior and its furniture. Some of the metal work of the late Gothic period has never been excelled. Painted decoration appears to have been confined to some of the more important spaces, but possibly some important details, like capitals, were gilded or painted in bright colors.

In the early period of French Gothic the tracery was simple, as exemplified in the Chartres Cathedral. An example of the simpler bar tracery is found in the windows of Rheims and of Nôtre Dame in Paris. The French rose windows were unexcelled, although the English produced bar tracery in the late Gothic which surpassed that of the French in artistic variety. As the tracery developed, it became more and more an ornamental feature. In France and in other countries in which Gothic style was developing along similar lines, the late Gothic acquired much fanciful detail. In this Flamboyant period the simpler geometrical designs gave way to flowing lines. This allowed greater freedom in ornamentation. Doubtless, this came from England, because much of northern France was in its control during this period. English Gothic is notable for its carving, but in figure sculpture it is inferior to French. Circular windows were not frequently used in England, but the great east and west windows were superb compositions. In Germany the carvers of wood and stone revelled in the opportunities which the Gothic style afforded them and many complex patterns were skilfully executed. Many of these carvings and metal work were excellent and they seemed to suggest a somber humor. Spanish Gothic is rich in ornament, but did not acquire a momentum comparable with this style in France, England, and Germany. In Italy the fundamental principles of Gothic style were not widely accepted. Some of the ideas were borrowed, but Gothic style as such did not develop. The art of the Renaissance overwhelmed these, as it was destined a century later to attract the interest of artists in countries to the north. Structural development attained great heights during the Gothic style and when the limit seemed to have been reached architects were ready for something else. Italy gave them the art of the Renaissance.

In most of the Gothic ornament, beauty was nicely combined with appropriateness, as is emphasized by the fact that, notwithstanding the profusion and richness of the ornamentation (Fig. 41), a distinct impression of embellishment is not given. The sense of appropriateness justifies and approves the ornamentation. During the decline of the period, this relation is not wholly satisfactory. The richness of decorative details, exquisite

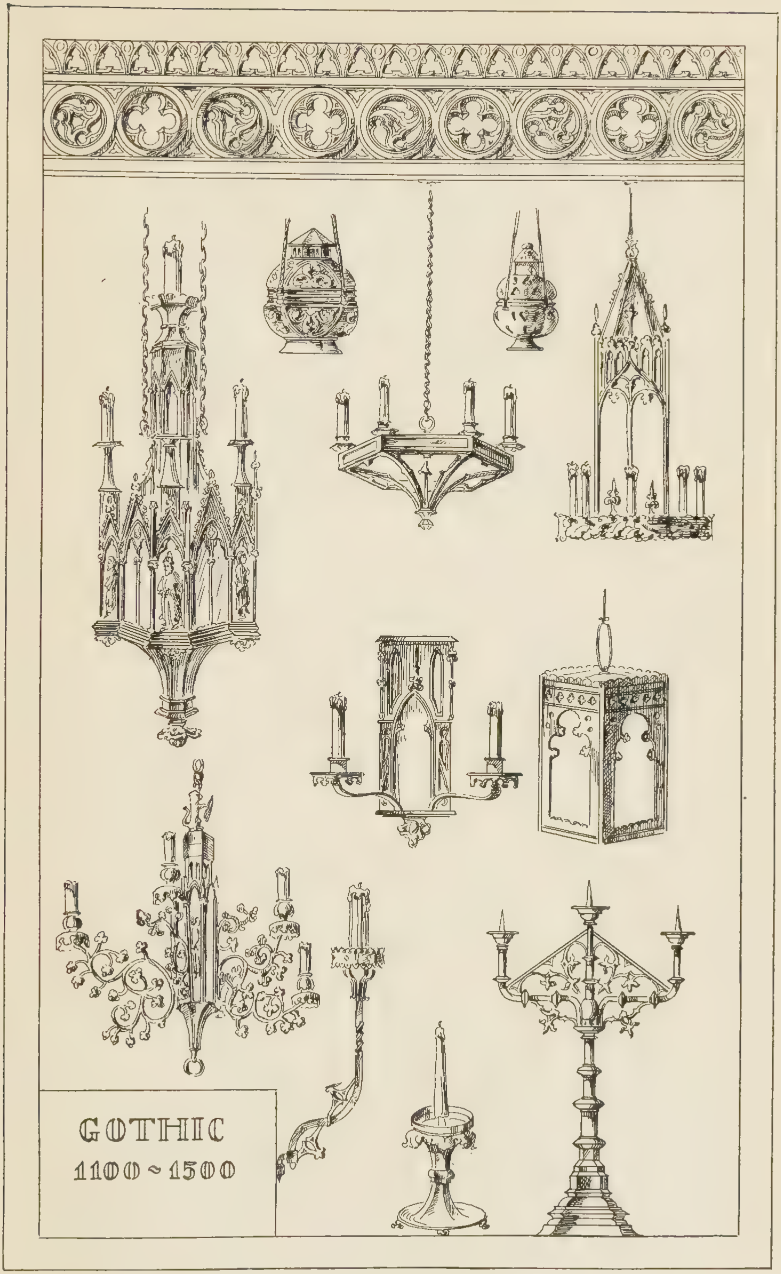

Fig. 41.

tracery, pictorial sculpture, gorgeous stained-glass windows, carved furniture, splendid textiles, marked this period. With a glorious climax in all of these, the Gothic style declined. It seemed as if the heights had been reached and artists naturally had to turn elsewhere for new fields to conquer. They had emerged from the Dark Ages in a glorious sunburst, which had reached the limit of expression. In Italy a new art style was developing, but it gained little headway to the north for a long time. The brilliance of Gothic art kept it in shadow until finally it was recognized as a new expression of a new civilization. That spirit which produced the great Gothic art had departed or exhausted itself. The spirit of the Renaissance had taken its place.

CHAPTER XII

THE RENAISSANCE

(1400 to 1800 A.D.)

This era was more than a revival of classical art. It was the result of an awakening of civilization to freedom in thought and to new ideals. Even modern science has its roots in this era, in which the individual began to recognize and to assert his right to inquire into Nature, into the universe, into religion, and into government. This awakening was foreshadowed, for example, by the literature of Dante, Boccaccio, and Petrarch and in science by the writing of Roger Bacon, an English monk and philosopher. This new intellectual freedom emancipated art from the control of the church and, thus freed, the artist found new inspiration and new fields to conquer. The invention of the modern method of printing by means of movable type broadcasted literature and knowledge very widely and gave impetus to this new freedom. The habit of inquiry awakened the Italians to the fact that they were the national descendants of those who produced the classic art of ancient Italy. Sculptors and painters had already revived the traditions of classic art. The Gothic period had developed carving and architectural construction. Prosperity was abroad again and both public and private life demanded luxury and splendor. Italy had never entirely lost the tradition of classic Roman art. It is true that it underwent many changes in the Romanesque, but even the powerful Gothic style could not establish an obliterating influence in Italy. Through it all, classic art did not die. Italy had many independent municipalities where individualism was growing. It is natural that the new freedom, which had been germinating during the final centuries of medieval civilization, should have arisen first from the soil of Italy. The spirit of the Renaissance still lives, for the intellectual movement which actually got under way is still going forward. However, the progress of art was checked and altered by the political, social, and industrial revolutions about a century ago.

The movement did not begin suddenly and is not divisible accurately into temporal periods. But, like all eras, there are certain marked characteristics which make it possible and desirable to divide it into periods as to style.

The Early Renaissance (1400 to 1500) may be considered to be the first century of the growth of this movement, and was confined largely to Italy.

The Middle Renaissance (1500 to 1550) was the period of the development of technique toward perfection and increasing skill in the use of classic art.

The Late Renaissance (1550 to 1800) began with a century of conflict between artistic license which strove for novelty and the precious refined freedom in the use of classic forms. This century is termed the Baroque period. This was followed by a Classic Revival (1650 to 1800), which was a further degeneration of originality, during which the forms of the Classical Age were borrowed bodily. The end of the Renaissance in art may be marked by the Empire period in France.

ITALIAN RENAISSANCE

(1400 to 1650 A.D.)

Florence seems to have been the place where the Renaissance actually began. Brunelleschi, an architect, after studying the classic monuments of Grecian and Roman art introduced their spirit into several churches which he built. Others followed his example and the revival of classic traditions spread into Venice, Milan, and throughout cities of northern Italy. The Early Renaissance artist was usually skilled in architecture, sculpture, inlay, metal work, and painting. Therefore, a complex intermingling of these crafts was characteristic in the works of that period. The Italians at that time were the finest craftsmen in Europe in many phases of art, but they were primarily decorators, and the decorative spirit is prominent. They were preoccupied in decorative effects of form and color (see Fig. 42). Beautiful objects for utility and for adornment were produced in great numbers. From many artistic viewpoints the work of this period has not been surpassed. The labors of those artists were applied to public, religious, and private buildings and their furnishings, so that posterity has had a source of tremendous variety in art to draw upon. The church was still a patron of art,

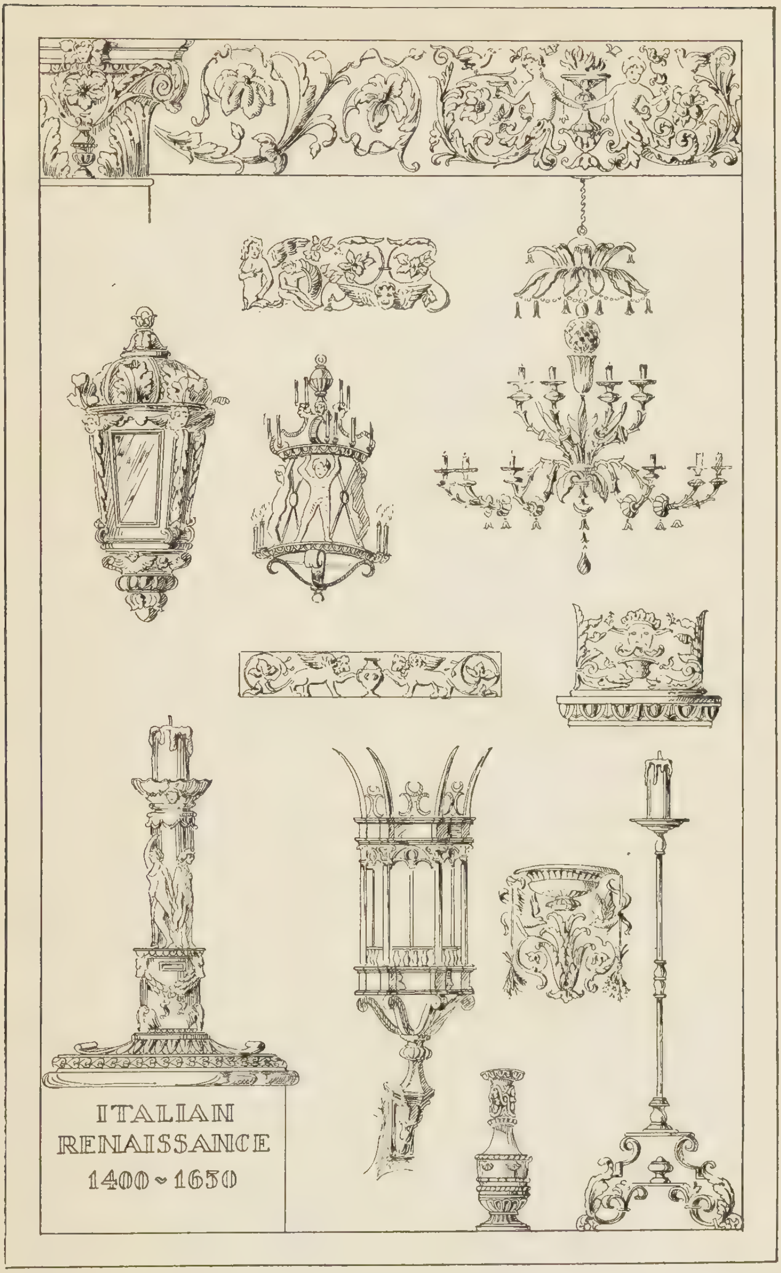

Fig. 42.

but it was not the sole dictator and consumer. Private and public life made their demands for splendor and had them fully satisfied.

The Italians, in their Early Renaissance, returned to Nature for inspiration and produced conventionalized natural forms which still retained many of the characteristics of plants. In a similar manner they retained the essential characteristics of other forms, such as human figures, birds, dolphins, feathers, wings, and lion heads, even though they conventionalized them. They did not merely copy the Grecian and Roman forms, but added to them something from their new intellectual freedom and development. They varied the acanthus leaf, the egg-and-dart, the dentil, and other classic forms which they borrowed. Their handling of ornament was such that they produced an appeal through pure esthetic quality which was independent of any symbolic meaning or esoteric significance. Their ornament was principally secular, although there was much sentiment in their sculpture.

In the Early Renaissance, archaeology was an unborn science, so the Italians made no attempts to reproduce the classic structures from their scanty ruins. They merely studied the art details of the fragments which were readily accessible. This, perhaps, encouraged a freedom of usage which, with their skill and refinement of taste, produced the wonderful art of the period. They freely modified the Corinthian capital and used it extensively. The Ionic order was employed to some extent, although it was greatly varied. The Doric order was rare. Bases of columns and of pilasters were not usually embellished with carving. Pilaster shafts were usually fluted and sometimes the lower portions of the flutings were partially or wholly filled with convex beads. The shafts of columns were plain.

The classic entablature survived throughout the Middle Ages and was often used in the Early Renaissance. The decorative forms were classic, but modified by the free, refined treatment characteristic of the period. The arches were commonly circular and the spandrels were generally ornamented (see Fig. 141). Many variations of the acanthus leaf were developed and foliated ornament was profusely used. Rosettes, festoons, figure sculpture, naturalistic fruit, leaves and flowers, infant forms terminating in nests of acanthus leaves, and grotesques were among the decorative forms employed.

Although vaulted ceilings were often used in churches, the horizontal ceiling, paneled or coffered, was common in most buildings. It was highly ornamented. Doorways were enriched with moldings and were usually flanked with pilasters supporting an entablature. The balustrade was originated during this period. Marble inlay was revived. Furniture was heavy and adorned. Textile and needlework were highly developed. Fresco was revived after discoveries of well-preserved stucco decorations from the classic Roman period. Painting was very highly developed during the Middle Renaissance. Venice became renowned for its glass-making in the sixteenth century. Metal work was exquisite.

When art develops to the greatest heights possible in one direction, it must find some other avenue for expression. Therefore, after a culminating height is reached, a decline is inevitable. So it was with the glorious period of the decorative art of the Italian Renaissance. Toward the end of the sixteenth century a decline in originality and in taste began. Striving for other avenues, novelty was a natural recourse, with the result that refinement was sacrificed. Surprise rather than charm seems to have been sought for in the Baroque period. Showy decoration became the rule, with a resulting confusion of forms and color which was in striking contrast to the art of the preceding period. Creative ability finally gave up the struggle, and classic art forms were copied without freedom and imagination. Archaeological researches resulted in the excavation of Pompeii in 1721 and in the discovery of much Grecian and Roman art. This gave new impetus to classic revival not only in Italy, but in France in the Louis XVI style and in England in the Late Georgian style of the Adam brothers.

Roman candelabra in bronze and marble and in relief representations were revived and used in many ways. They had a vertical stem, usually of circular cross-section and highly embellished with ornament. Exquisite lanterns and wall brackets for candles appeared during this period. The chandelier was elaborated and the candles were often arranged in tiers. The lighting fixtures of the Italian Rennaissance are still sources of inspiration to the designer of the present time; however, the greatly increased possibilities of modern lighting call for ingenuity in the adaptation of the splendid ornaments of that period to the needs and possibilities of the present.

FRENCH RENAISSANCE

(1500 to 1800 A.D.)

In France a desire for greater freedom of expression is evident in the Flamboyant Gothic period, but it did not powerfully assert itself for a century after the Renaissance was born in Italy. Notwithstanding the change in thought which was taking place, it is certain that the Renaissance in France is due to a great extent to the irresistible invasion of brilliant Italian art. At first, it resulted chiefly in the modification of Gothic details, but later it was introduced by French kings who invaded Italy and became enslaved by its art. Francis I, who began his reign in 1515, erected great palaces which were rendered magnificent by the influence of Early Italian Renaissance. For a long time the Gothic spirit persisted in France and the skill in wood carving which was acquired in that previous period was gloriously utilized, particularly in Flemish art. Finally, when the French Renaissance was well under way, its art bore a close resemblance to that of the Italian, whence it came (see Fig. 43). The excellent furniture of the later period was more often covered with fabrics, so that the frame construction became a minor factor, except as it gave form to the furniture. Inlays of wood, metal, ivory, and ebony were introduced, but relief prevailed. Upholstery of furniture became common after 1600.

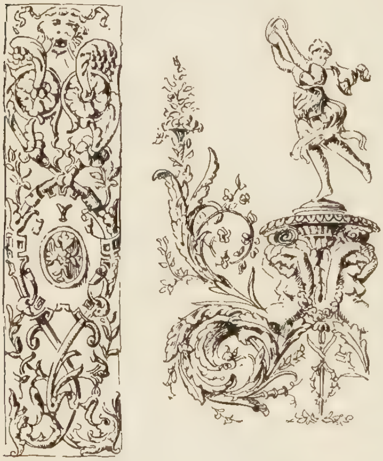

FIG. 43.—Early and Late French Renaissance.

Italian and Flemish artists and craftsmen came to France and brought with them some influences. The Italians introduced scrolls and arabesques executed in their best antique manner. Naturally, there was much conflict during the transitional period, but this alone does not account for the variety of styles or phases in the French Renaissance. The French people were fundamentally of two separate strains—the Gallic and the Latin. The former were romantic, full of life, and individualistic to the point of possessing little patience for orderliness; the latter were classic and orderly, and their designs were subservient to formality and symmetry. Thus, we have an art period in France in which Gallic vitality and originality were tempered by Latin good taste and restraint. The various styles of the French Renaissance show these two influences in varying proportions.

The works of this period are associated with the names of leading artists, perhaps due to the availability of historic records. The various styles are associated with the names of rulers. The French Renaissance reached a high state of development during the reign of Louis XIV, who brought together under royal patronage artists from many lands. Then there was a decline to the Rococo period. Some authorities mark this as the end of the French Renaissance, but for the present purpose it seems best to include even the Empire.

The furnishings were similar to those of the late Elizabethan until about 1600. Ceilings of the earlier part of the era were "beamed." Fireplaces were provided in all important rooms and they were elaborately decorated. Wood wainscoting, which was practically unknown in Italy, was quite prevalent in France. Corinthian capitals prevailed until 1550, after which Doric and Ionic orders appeared. Highly ornate balustrades and carved stone parapets were used instead of the classic Italian balustrade. Textiles were largely imported in the earlier periods.

During the reign of Louis XIII (1610 to 1643) there was a tendency toward the classicism of Louis XIV, but the Baroque exaggeration was in evidence—doubtless a result of the Gallic spirit. Tapestries and brocades began to be used in upholstery, which was just beginning to supply ease and comfort in furniture. Four-legged tables from Flanders, Germany, and Holland began to appear. Chair legs were square and tapering, although curved and turned ones were also in evidence. Large cabinets, architectural and ornate, were in use. Enamel work, inspired by Italian majolica, was a product of this period. The art of this period was Baroque, restless rather than reposing.

Louis XIV (1638 *to* 1715).—During the Early French Renaissance the artists of France were learning much from the foreign artists who worked in their country. The French assimilated all this and finally reached a state of development when they very ably dominated their own art. It was then that the tables were turned and Italy and Germany began to borrow much from them.

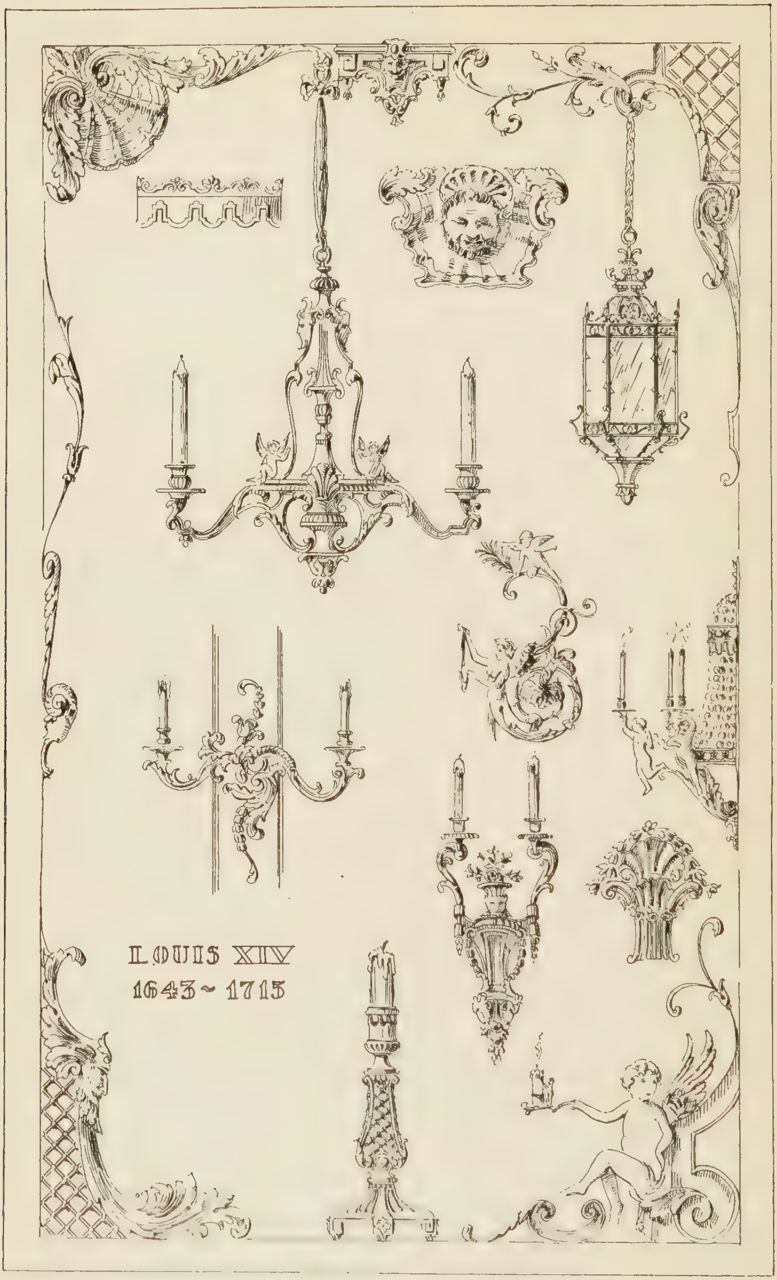

Fig. 44.

Fortunately for art, Louis XIV, who came to the throne in 1643, was very conceited and extravagant, loved luxury and magnificence, and was a generous patron of art. He possessed a well-defined taste for the fine arts and the great structures which he built afforded much opportunity for the finest expression of the French artists. A pure French style (Fig. 44) was the result. The king favored classic art modified by French skill, intellect, and character. Therefore, French sculpture, architecture, painting, interior decoration, and furniture show a serious classic tendency modified by the fancy and taste of French artists, who were now quite capable of independent interpretation. In 1655 Louis XIV established the Academy of Painting and Sculpture and eventually dominated it. In 1663 he established a royal manufactory—the Gobelins—in which splendid tapestries and other textiles, as well as furniture, jewelry, and metal work, were produced. These became great centers of art which far outshone the work of other schools. This was the beginning of a period of supremacy of French art.

The climax of the French Renaissance was a period of great enthusiasm and ambition in art. The names of many great artists became widely known. They gave of their best because of the opportunity for expression which also led to royal favor. Ceiling paintings were superb. Walls were decorated with textiles, paint, wood, or leather. Rich velvets, damasks, brocades silks, and Oriental carpets enriched the interiors. Ceilings were also embellished with stucco and wood moldings. Exquisite furnishings, such as mirrors, bronzes, screens, porcelains, clocks, consoles, sideboards, marble table tops, and upholstered furniture, were made without apparent thought of cost. It was a prosperous country, with a grand monarch who loved and encouraged art, and this spirit is reflected in the art of Louis XIV. The early struggle between the Gallic and the Latin elements in the French artists resulted in this period in a victory for the Latin in exterior architecture, but in the interiors of palaces and other pretentious buildings the Gallic triumphed. Curved and flowing lines displaced the severe straight lines of Louis XIII style. Gold-framed mirrors were introduced on the walls and the use of marble increased.

The furniture of Louis XIV reflected the splendor and the extravagance of the time. Large and heavy pieces were severe in outline and bore some relief carving. The lighter pieces had flowing lines and were delicately carved and often gilded. For example, the legs, arms, and backs of chairs possessed flowing lines. Rich surface decoration, inlays of wood, brass, and tortoise shell, and ornaments of gilded bronze were applied to furniture. Doubtless these ideas came from Florence. Seats and backs of chairs were covered with brocades and tapestries woven of designs to fit the areas. Woodwork on walls, doors, and church furniture was paneled and carved with flowing acanthus leaves, palms, and scrolls. Skill in metal work is demonstrated in grilles, sconces, light brackets, and other articles. The royal tapestries produced at the Gobelins, as a rule, were of great size for wall hangings and they depicted episodes in mythology and antiquity or were purely decorative in design.

Louis XIV occupied the throne of France for seventy-two years. Art did not suffer from restrictions of ecclesiastical ideas and symbolisms. It knew no bounds except those of artistic restraint. When this king ascended the throne, French art was soundly founded and headed in the direction of achievement. The patronage of a sympathetic king was all that was needed to produce a wonderful art style. After the death of the king, an eight-year regency held the reins of government. This proved to be a transition period between the serious classic art of Louis XIV and the capricious and exaggerated art of Louis XV.

Louis XV (1715 *to* 1774).—This period is characterized by less seriousness in design and a tendency to modernize. No distinctly new ornament was introduced. The difference between this style (Fig. 45) and the preceding one was largely in manner. The heroics of classic art were replaced by comedies. Parrots and domesticated animals took the place of winged horses and lions. Human figures were often replaced by monkeys, to appeal to spirits jaded by high life. Tapestries depicted modern life more or less idealized. The few straight lines which still existed in furniture were entirely abandoned, and structural expression disappeared. Lacquer finish appeared and with it Chinese landscapes.

Bulging surfaces and outlines were introduced in furniture by the use of veneer. Inlays of tortoise shell and metal gave way entirely to inlays of exotic woods. The spirit of the Louis XIV persisted in many works and served as a stabilizer and, notwithstanding the riotous frivolity of the period, there was originality in treatment and often very creditable execution. The Louis

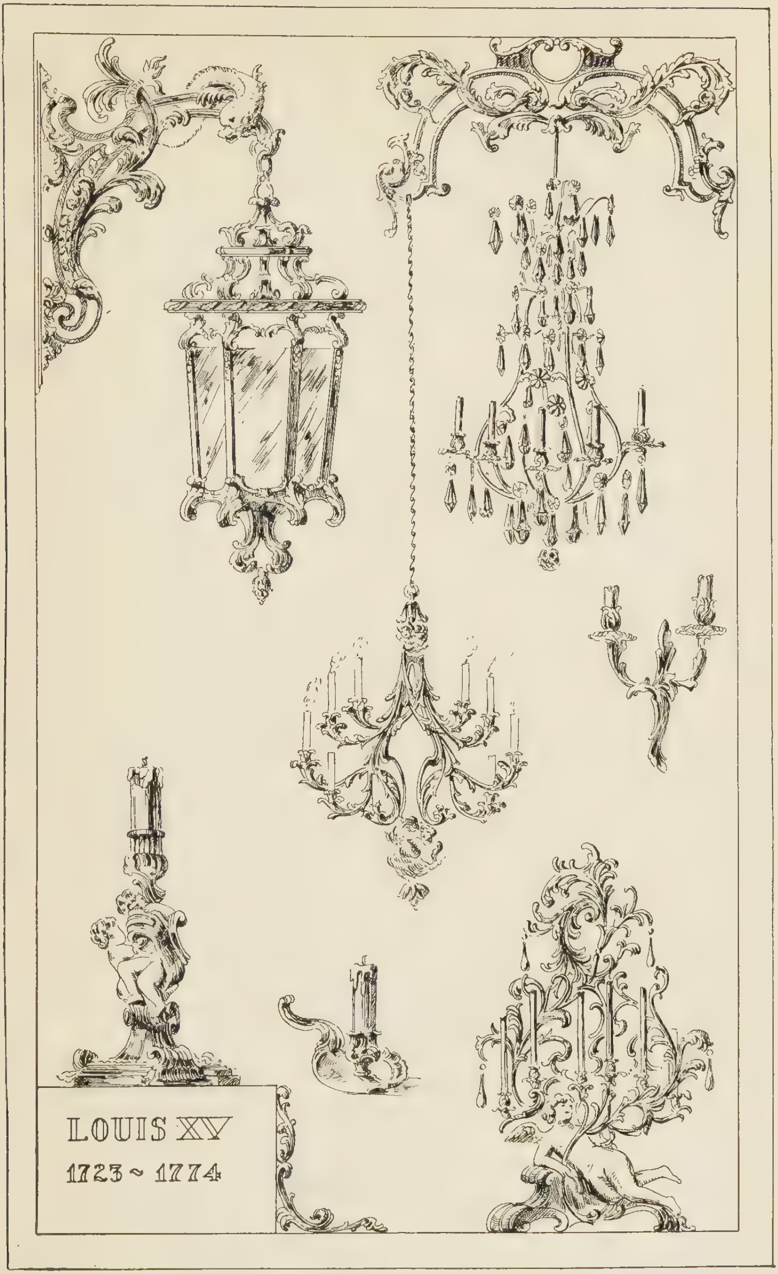

FIG. 45.

XV spirit may be considered an attempt to escape the established traditions, a squirming to find new heights to conquer. It did not completely lose its classical inheritance and it did not rebel from tradition to the point of ignoring foundational laws of design. Metal work furnished an excellent medium for free design and much creditable work was produced.

The later Louis XV is termed Rococo. This was an impressionistic phase in which rock, shell, and stalactite forms were substituted, in the Baroque manner, for the classic motifs of Louis XIV. It was not uncommon to find incongruous relations, such as a pheasant much smaller than a rose beside it. Fantasticism was one of the outlets of the rebellion. Louis XV, in negotiating trade relations with the Chinese, was presented with many gifts from the Far East. Thus, Chinese vases, dragons, birds, pagodas, etc. were introduced into French art. Chippendale borrowed these for his works in England. The Chinese influence found its way into residences, where, for example, the walls of the bedroom would be covered with painted Chinese scenes and lacquered, and the ceiling painted with pictures, and mirrors set into it. White, gold, bronze, and mahogany were common color schemes. Chinese motifs appeared in textiles.

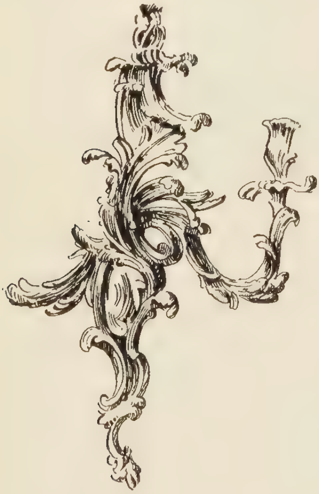

Fig. 46.—Rococo.

The Louis XV was the natural result of the great culminating climax of French art in the Louis XIV. The limit had been reached and artists were searching for new fields. This desire for freedom bred caprice, frivolity, and fantasticism and accounts for the immediate acceptance of Chinese ornament, which was novel in Europe. The natural result was the Rococo style (Fig. 46), in which the Baroque style of Italy was revived. The walls and ceilings were decorated with female faces and forms. Gorgeous glass chandeliers were hung from the ceilings. Mirrors were used as wall panels and even in the ceiling. All this reflects the wild extravagance of the period. However, a change was inevitable from this extreme. In 1709, Herculaneum was excavated and in 1748 the ruins of Pompeii were uncovered. French artists turned to these relics of classic art with enthusiasm and before the death of Louis XV a return of classic feeling began to manifest itself. With this inspiration and the influence of the refined and cultivated Marie Antionette, the next period, that of Louis XVI, settled down to a more serious régime in art.

Louis XVI (1774 *to* 1793).—The young King Louis XVI did not possess the forceful character of Louis XIV, but his moral quality was far superior to that of Louis XV. Marie Antionette of Austria, whom he married, was a woman of refined though extravagant taste. These characteristics of these royal patrons doubtless gave encouragement to the growing tendency of art to forsake the restless ornamentation of the preceding period for simplicity and refinement (see Fig. 47). The classic spirit substituted straight lines for many of the exaggerated curves of the previous style. A purification of decorative forms was sought for. As already stated, the discovery of ancient ruins of classic art in Pompeii, Herculaneum, and eslewhere gave impetus to a revival of classic traditions. The new spirit became so dominating and entrenched that it survived even the harrowing years and destructiveness of the French Revolution and entered the Empire period. In England it influenced the work of Hepplewhite, Sheraton, and the Adam brothers.

In architecture the classic Roman orders dominated the design as in the late Louis XV period. In furniture, straight lines predominated, in striking contrast to the exaggerated curvilinear forms of the early Louis XV. The legs of furniture were slender and tapering and usually free from underframing. It is true that some of the heavier pieces seemed rather too flimsy. Most of the supports were fluted and of classic detail. The flutings were varied considerably by inserting beading or shorter flutings. Metal was sometimes used for these inserts. The foot of the legs consisted of a ring, an acanthus cup, or vase form. A conventionalized torch was used at the top. As in the Louis XV period, the chairs were highly perfected frames for upholstery. Some of the woodwork was delicately carved. The arms of chairs were curved and the backs were often approximately square, but, if not, their curves were very gentle. The textiles used in upholstery were extremely rich. Fine stripes with floral intervals were often used in these as well as naturalistic flowers and foliage. Delicate tints were used for the furniture, which was

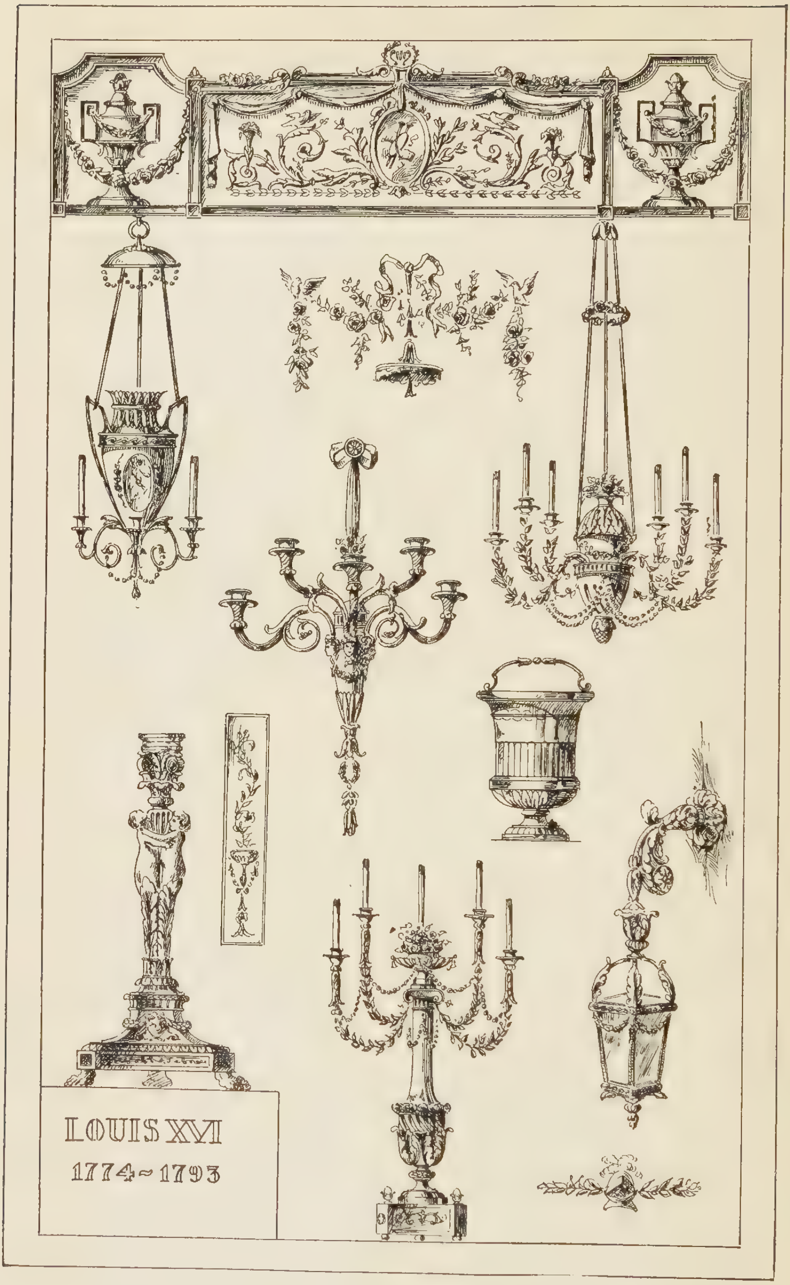

Fig. 47.

enameled white, or nearly so. Mahogany was introduced in this period. With it and tulip and rosewood quite a variety was obtainable. These woods were often left natural in finish, but the chairs were usually gilded or enameled. Chinese lacquer was at its height and there was a tendency to expose the beauty of the wood where it was used for the larger areas.

Much gilded bronze mounting was employed for ornamenting the wood. The carvers were skilled in executing exquisite details. A flat panel would be the background for delicate wreaths. The feet of table legs would be enveloped in a bronze ferrule and bronze caps would surmount the tops of the legs. Garlands of roses, bundles of shafts, Cupid's arrows, and forms suggestive of music accessories were among the motifs of ornament. The famous porcelain plaques made by the Sevres potteries (established by Louis XIV) were inserted into furniture. Chinese vases were mounted in bronze.

In interiors, fluted pilasters between the floor and cove were quite characteristic. The spaces between were paneled and decorated with classic designs. The doors were rectangular and were decorated with delicate scrolls, vases, and animal forms.

The ironwork of this period is noteworthy. Balustrades, stair railings, and balcony parapets of wrought iron came into use and many iron gates and grilles were installed. These were of fine grace and simplicity.

The sconces, candlesticks, light brackets, chandeliers, and light stands were often of the slender and graceful types of Pompeian tripods. Much classical detail was employed in their embellishment.

The reign of Louis XVI and this period style ended with the French Revolution, which exacted a terrible price of the extravagance of the aristocracy. For fifteen years France flowed with the blood of turmoil. Then Napoleon came and established order and a new absolutism. Architecture now became more classically Roman than ever. This was the Empire period.

EMPIRE

(1804 to 1814 A.D.)

This period is not commonly included in the Renaissance; however, it is considered at this point as a matter of convenience. Following the Revolution in France there was a transitional

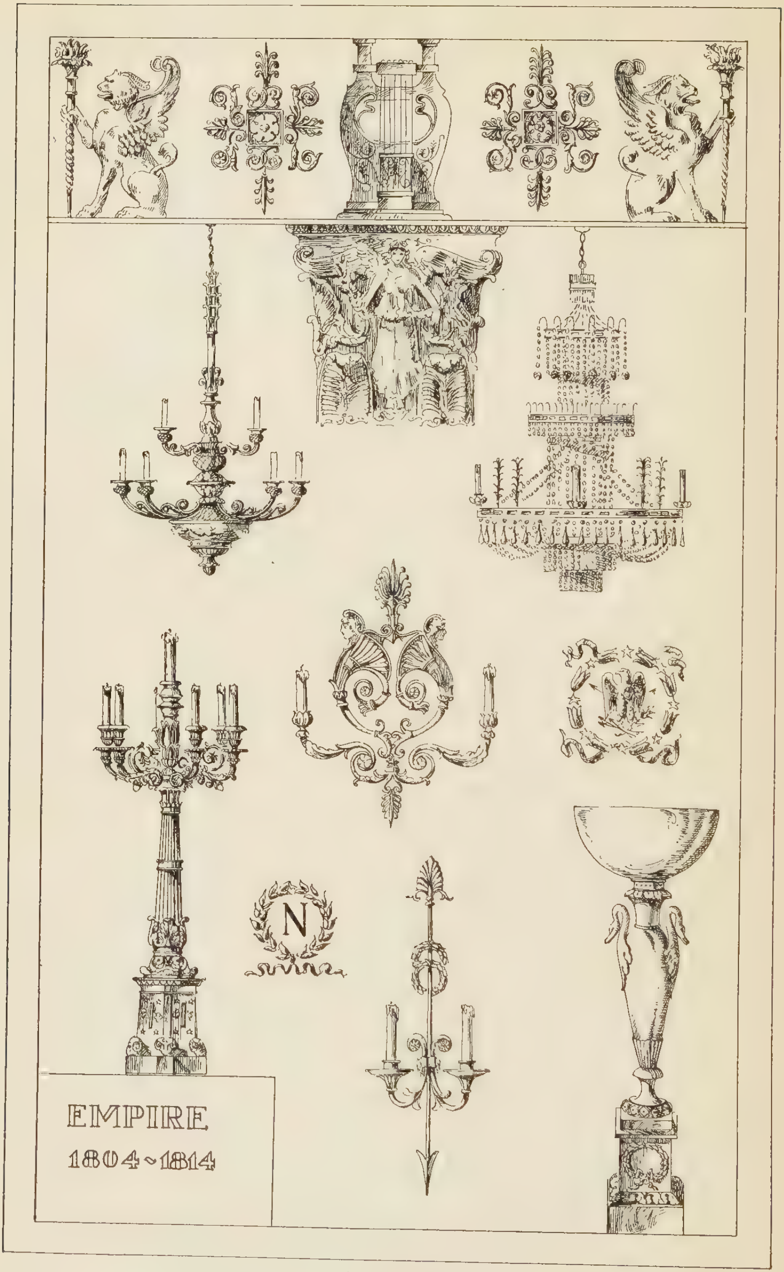

Fig. 48.

period—the Directoire (1795 to 1799) and the Consulate (1799 to 1804). During this period the Pompeian classicism persisted. Naturally, the people were not sympathetic toward anything too suggestive of the preceding royalty, and this feeling gave an excellent opportunity for a further purification of art toward Roman classicism. With the appearance of Napoleon, Roman art was also stimulated, for it suggested much of this modern conquerer. Even Napoleon's conquest of Egypt influenced the art of the Empire period. The sphinx, for example, was carved into the arms of the chairs and elsewhere. As the successes of this military genius multiplied, the French art utilized much that was symbolic of conquest. The wreath, laurel branch, helmeted head, lance, eagle, torch, bee, crown, Napoleon's initial, and other imperial emblems became motifs for classic appliqué. The style (Fig. 48) was massive, formal, stately, and refined.

The architecture was imitatively Roman, but in the interiors Gallic originality was manifest. The art was Romanized, but retained much of the elegance and spirit of the French. The tapestries were not pictorial, but of conventional design in more or less sober colors. The classical lightness of the preceding style disappeared from furniture and was replaced by a classical massiveness less embellished with gilded bronze than in the preceding period.

The greatness of Napoleon seemed to concentrate the interest of artists upon him and his personality seemed all-pervading. The French love of beauty spared the art which was not too reminiscent of the royalty, and the government during the Directoire even extended its patronage to art. Thus, when Napoleon came from his Italian and Egyptian campaigns art interest was not dead. Better still, the artists still lived. When this picturesque genius became emperor, art was readily revived and inspired by him. The dainty art of Louis XVI was suggestive of gardens and boudoirs. That of the Empire radiated the spirit of the conquerer through the classic art of Imperial Rome.

Furniture was simple, massive, and severe and the wood was finished natural. The smaller chairs were of mahogany and had delicate mountings and textile coverings. The larger chairs were carved in keeping with the structural forms. The horn of plenty, heads of rams and lions, winged griffins, lions' feet, and grotesques of human heads and shafts for bodies were among the decorative forms. Round tables with marble tops were common.

The supports often had three lions' feet. Veneer was used extensively and there was a revival of incrustation. The gilded bronze mounts were responsible for much of the beauty of Empire furniture. The anthemion was widely used. Female figures were used for mounts on large surfaces. The wreath of the hero, the torch as the brand of victory, the letter N, and the Napoleon bee are among the imperial emblems employed in decoration. The decorative fabrics were colorful and ruby-red was a favorite.

Among the art creations of the Empire, the candelabra based on Pompeian art were among the most beautiful. These were not only for use on tables and mantels, but some of them were very tall, resting on the floor. Exquisite chandeliers of glass crystals and tiers of candles are among the rich heritages of this brief period.

The Empire style spread into Italy and Germany and finally into the United States. Between 1820 and 1840 the Empire style predominated in furniture in the aristocratic residences in this country, although the style was simplified. Its forms were also introduced into clocks.

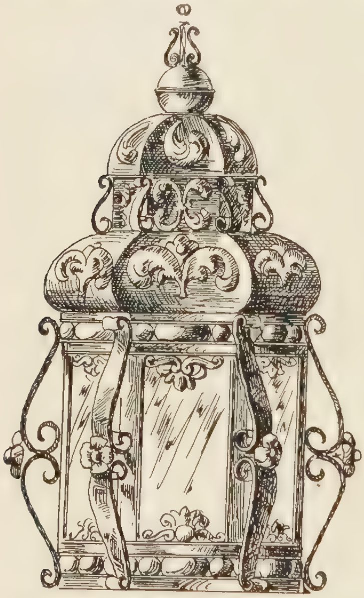

Fig. 49.—German Renaissance.

GERMAN RENAISSANCE

(1500 to 1700 A.D.)

In Germany the influence of the Renaissance met much resistance in architecture, owing to the foothold which the Gothic style had obtained. Some artists, such as Dürer and the Holbeins, did much to introduce the new spirit, but little progress was made until German artists became familiar with Italian art through increasing published works and through the work of Italian artists who came to Germany. In 1521 Martin Luther was placed under the ban of the empire for his criticism of certain Catholic practices. He had already been placed under the ban of the Church. Subsequent events led to many protests by his sympathizers, with the result that Protestantism was born. This was one of the many evidences of the renaissance in thought and individual freedom. Protestantism was opposed to decoration, so that, in Germany, Renaissance art was not introduced into ecclesiastical structures. This was one reason why German Renaissance is not so much associated with monumental buildings, but is confined more to decorative details (see Fig. 49). The Thirty Years' War to a great extent checked the architectural development in this direction and no complete and powerful Renaissance style was developed which included architecture and all of its accessories in a harmonious system. The German Renaissance began in about 1500 and it finally passed through the Rococo style, which ended about 1700.

FLEMISH RENAISSANCE

(1500 to 1700 A.D.)

The art of the Renaissance invaded the Netherlands, in part, directly from Italy, but largely through Germany, France, and Spain. In the sixteenth century the countries which are now Holland and Belgium were under Spanish domination and were a part of the Holy Roman Empire. With the Reformation, certain tendencies developed eventually into a separation. The Dutch Republic was established in the north, and Flanders (now Belgium) in the south developed independently. With the aid of England, the Dutch were successful in their conquest of Spain in 1600. In the seventeenth century the Dutch traders brought the art of the Far East to Europe and its influence was thus increased in western art. The Dutch were powerful in trade and they carried the art products of Holland and Flanders abroad. In England these influences were strongly felt from the Elizabethan to the William and Mary periods.

The weaving of tapestries in Europe was begun by the Flemish in about 1100, and for four centuries other countries borrowed from Flanders. About the same time the famous Cordova leathers were introduced into Flanders from Spain and later the gilded and painted leathers of the Flemish were renowned. Wood carving developed to a high state. Such painters as van Eyck developed modern oil painting, which became the fashion. Lace making was a development of the Renaissance and the Netherlands contributed many fine laces. During the Renaissance, Flemish artists and craftsmen were much in demand in France, England, and other countries.

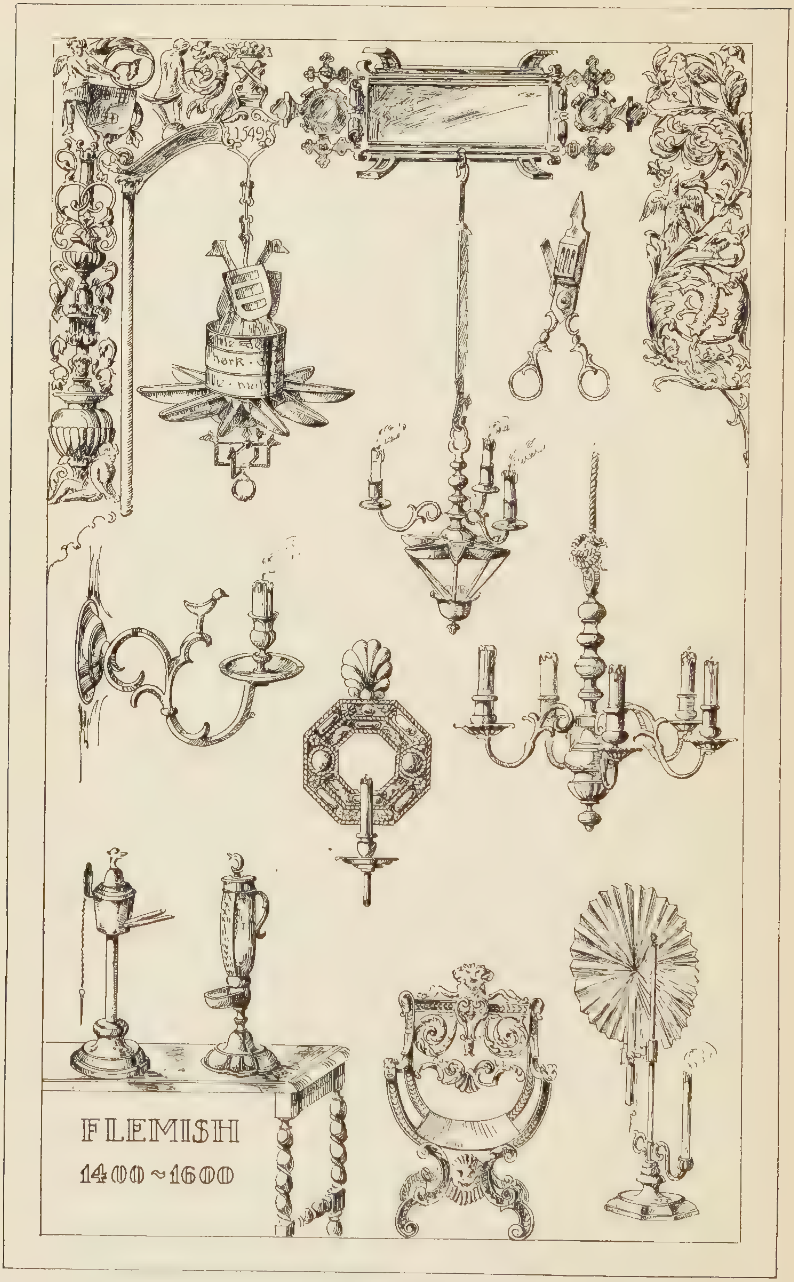

Fig. 50.

Flemish architecture, which is characterized by great decorative skill in the late Gothic structures and their accessories, declined during the Renaissance. The Flemish (Fig. 50) seemed quite opposed to the classic spirit. Their taste was for animation and multiplicity of detail. Classic art, which was the foundation of Renaissance art, is characterized by repose. The Baroque style, therefore, was more suitable to the Flemish restlessness than the more classic styles of the Renaissance. The skill and the boldness of the wood carvers were much in evidence in architectural accessories.

Where the Flemish were somewhat lacking in the necessary taste for large-scale design, they were adequately qualified to design furniture. Here their excellent craftsmen enjoyed freedom and they carved profusely. The elements of many of their designs came from Italy, but they were so modified by Spanish, German, and French influences that their work acquired very marked characteristics of the arts of these three countries. Flemish furniture was sometimes overloaded with decoration and this tendency was always apparent. Among the decorative motifs employed were the arch, the human figure, and the gaine (a human half figure terminating in a sheath-like pedestal). Pilasters, columns, and panels were common in the massive furniture and in the latter part of the Renaissance turned spindles and connecting bars were introduced into the construction of chairs, tables, and other articles of furniture.

The Dutch Republic established its independence in 1579. The preceding oppression by Spain and the later associations with Protestant states of Germany inhibited an independent art style. Stone was lacking, so brick construction developed, and this structural material naturally limited the size and composition of building. On the other hand, it is responsible for much of the charming quaintness of the modest Dutch buildings. Their ornament was suggestive of German influence. Scrolls, finials, strapwork, appliqué ornament, gaines, and carved stone ornaments inserted in brickwork were common. In furniture and interior decoration many of the same elements were frequently employed. In the late Renaissance wavy lines, swelling fronts, gilded bronze ornaments, veneers, and lacquer were introduced, as in France and other countries.

Delft was a center of ceramic art after 1584 and its products became famous. The decoration consisted of floral designs, naturalistic and conventionalized, and also of pictorial scenes. Oriental influence appeared later and the ceramic products became of a finer character. Blue predominates in these wares, although in the later products yellow, red, and other colors began to appear. The decorations also were extended to include escutcheons, scrolls, human figures, and delicate but complex floral designs (see Fig. 51).

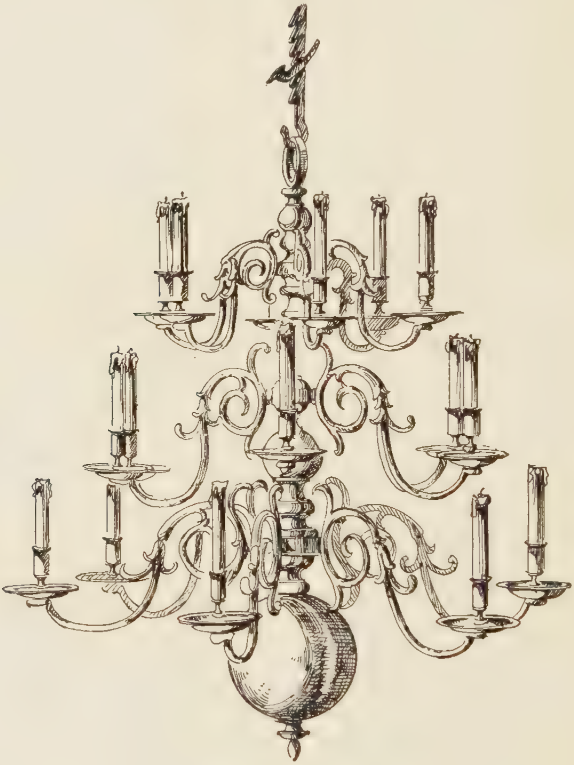

Fig. 51.—Dutch.

ENGLISH RENAISSANCE

(1500 to 1800 A.D.)

The Renaissance was under way a century in Italy before it began to make an impression in England. Henry VIII, who reigned from 1509 to 1547, was on the throne before some of the finest structures of Perpendicular Gothic styles were completed. Then the Tudor Gothic became prominent, and this style persisted until after Elizabeth ascended the throne in 1558. This Gothic style was so typically English that the new spirit of the Renaissance made slow progress. The stable, conservative character was reflected in the Gothic. After Henry VIII renounced papal authority, Protestantism grew in favor until it was made the national religion by Elizabeth. Thus, through Protestantism England's relations were more with the Netherlands and Germany than with Italy and France and these relations influenced her art. Before the Reformation in 1534, however, Italian artists were employed in England, so that Italian art was thereby introduced. Many minor works of these Latin artists and craftsmen are associated with English architecture, interior decoration, and furnishing, but the influence on English art in general was very meager (see Fig. 52).

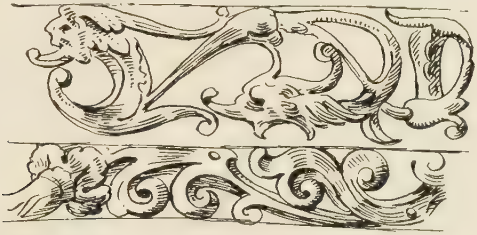

Fig. 52.—Early English Renaissance.

Tudor or Elizabethan (1509 *to* 1603).—The early English Renaissance is named after Queen Elizabeth, but it began before her reign (1558 to 1603) and its influence extended throughout the Jacobean. The transition from the Gothic to the Renaissance style took place during the half century from the ascension of Henry VIII to the throne and the reigns of Edward VI and Mary. During the reign of Elizabeth, the Spanish Armada was defeated and peace generally prevailed. Commerce developed and the resulting prosperity created a great demand for private and public buildings. Education and travel increased and with all these influences art appreciation developed. Architecture remained English, but the details were influenced by the new spirit in art. Classical proportion and correctness in structures was lacking and classical design and details did not flourish. Works were picturesque and possessed a national character, but were not of refined beauty. They show very markedly the handiwork of Flemish and German artists and craftsmen (see Fig. 53).

In interiors, the walls were often elaborately paneled and ceilings were decorated in stucco. The ceilings were rarely coffered or beamed, but were covered with relief ornament in panels formed by ornamental ribs. Walls were usually covered with wood wainscoting for several feet above the floor and the areas above were hung with textiles, although sometimes decorative stucco was applied. Native oak was plentiful, so that it was used where wood was desired. Balustrades, stairways, panelings, mantelpieces, wainscoting, and furniture were made of oak.

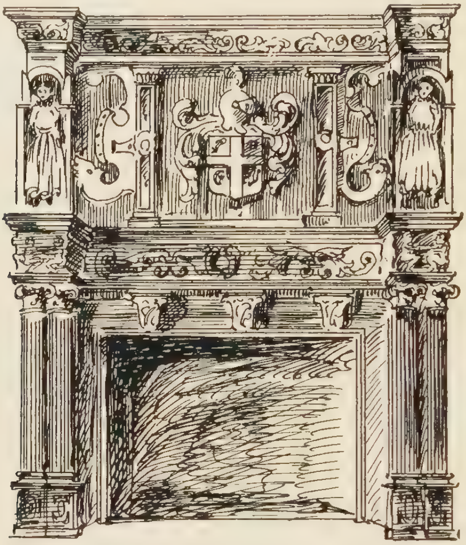

Fig. 53.—Elizabethan mantel-piece.

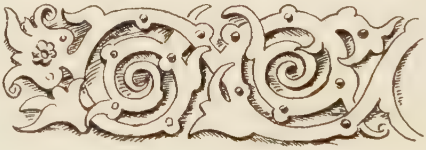

Fig. 54.—Elizabethan strapwork.

The furniture was solid, massive, and more or less simple in design. Chests, tables, benches, and chairs were the common articles of furniture. On these and other woodwork were some carvings. A carved arch between pilasters or gaines with strapwork appliqué was a common decoration for large furniture and mantel pieces. The larger articles of furniture, such as cabinets and beds, had rather coarse and even grotesque pediments and entablatures, patterned in general after classic forms, but they were little more than travesties (see Fig. 54).

The Elizabethan or Tudor style may be considered to extend over the reign of Henry VIII, Edward, Mary, and Elizabeth.

Jacobean (1603 *to* 1689).—The same influences which characterized the art of Elizabeth's reign continued into the reign of James I (Jacobus), the founder of the Stuart line of monarchs. There was a tendency toward refinement and delicacy during this period compared with the previous one. The forms were more and more like those of Flemish and German Renaissance, although the style remained distinctly English. Circular arches, balustrades, and gaines became numerous, and the coarse imitations of classic entablatures and pediments were somewhat refined. Gables with curved outlines began to appear. Nailhead ornament was borrowed from Germany and the Netherlands. Flemish leather work was introduced. Heraldic ornament was used on panels. Turned legs and spindles were substituted in furniture for the massive turned supports of vase-like forms of the late Elizabethan. S-forms and C-forms appeared. Pretentious interiors were furnished with tapestries and elaborate fabrics. Walls and ceilings were elaborately stuccoed. Oriental fabrics were introduced.

English Renaissance art was altered greatly in style by the work of Inigo Jones, who was born in 1573 and studied art in Italy. He developed a neoclassic style in the structures which he designed. The Germanesque Elizabethan art, picturesque and amusing, gave way to a sober classic correctness. After the death of Jones in 1652, Christopher Wren (1632 to 1723) continued to produce well-composed, dignified work along this neoclassical line.

Wood-paneled chairs began to be displaced about the middle of this period by carved chairs of Flemish type. Cane seats and backs came from the East, but did not appear in English furniture until after the reign of Jacobus, probably about 1650. The fluted foot of chair legs was of Spanish origin. The ball or bulb foot came from the Netherlands. The scroll foot came from France by way of Flanders. The feet of Renaissance chairs were sometimes of cubes, disks, flattened balls. The claw-and-bell foot belongs to the Queen Anne period, although the form developed in Louis XIV and late Jacobean periods. Animal feet for chair leg terminals were generally used by the Greeks and Romans, and therefore are found in Renaissance art. The chairs of the late Jacobean were graceful and light and when the open and cane backs took the place of the carved panel they appeared less rigid and uncomfortable.

Glass mirrors were rare in the Elizabethan and Jacobean periods. They did not begin to become common until nearly 1700.

The Jacobean style (Fig. 55) may be considered to extend over the reigns of James I, Charles I, Charles II, and James II.

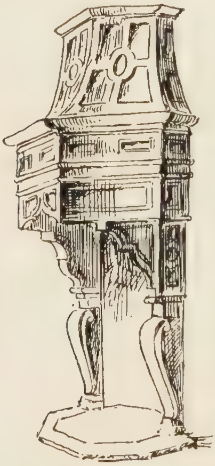

Fig. 55.—Jacobean mantel-piece.

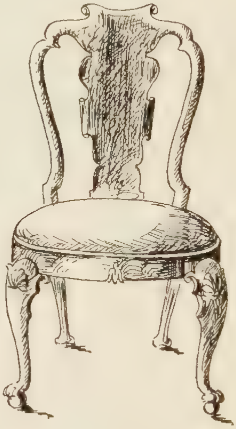

Fig. 56.—Queen Anne.

Queen Anne (1689 *to* 1714).—Queen Anne occupied the throne from 1702 to 1714, but the period style named for her may be considered to include the short preceding reign of William and Mary. Following the reign of James I, the styles became more or less confused and no temporal divisions are strictly satisfactory. French, Flemish, and Italian styles were being adapted to English tastes and conditions. During the reign of Charles II, French influence from the Louis XIV period became prominent. Upholstered French chairs and furniture with wood inlays appeared in England. English chairs acquired cane seats and backs and scroll legs. Settees and double-seated chairs appeared. James II in 1685 introduced the tall-backed French chair. These two weak Stuart kings were easy prey for the extravagant French court.

When Mary ascended the throne with her Dutch husband, William, they brought with them Dutch furniture and, therefore, a Dutch influence in art. The ponderous furniture of Elizabethan and Jacobean periods gave way to sturdy Dutch furniture of lighter effect. The cabriole leg, like a long slender scroll, was introduced for the first time into England. This leg was almost devoid of ornament (see Fig. 56). Simplicity in form was the tendency during the Queen Anne period. Flat uprights in the backs of chairs and the claw-and-ball feet of chair legs now appeared. A delicacy and refinement was creeping into furniture and paving the way for still more progress in this direction. Highboys and Queen Anne tables are characteristic of the period.

Interiors of this period had low dadoes, wall panels for pictures or textiles, cornices, coves, and ceilings embellished in plaster. Mahogany was not in general use. Oak, walnut, and sycamore were commonly employed. Columns and pilasters were used in interiors with an effect of grandeur. Chimney pieces were not continued to the ceiling as previously.

GEORGIAN

(1714 to 1820 A.D.)

A variety of influences were at work during the century in which the three Georges reigned. From the viewpoint of art, the Georgian was not a single, distinct period by any means. During the reigns of George I (1714 to 1727) and of George II (1727 to 1760), French art was very influential in England. The height of the French Renaissance was reached in the reign of Louis XIV, which ended about the time that George I ascended the throne, and, naturally, English taste was influenced. Chinese motifs were popular in France and they also became the vogue in England. The architectural developments and

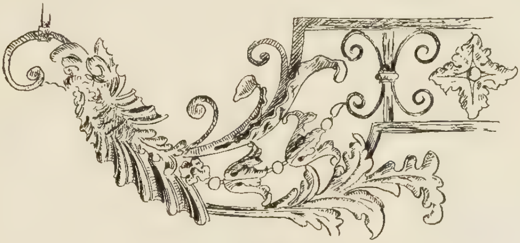

Fig. 57.—Late English Renaissance.

monumental art was not contributing much that was new. Renaissance influence (Fig. 57) was continuing its successes over Gothic traditions.

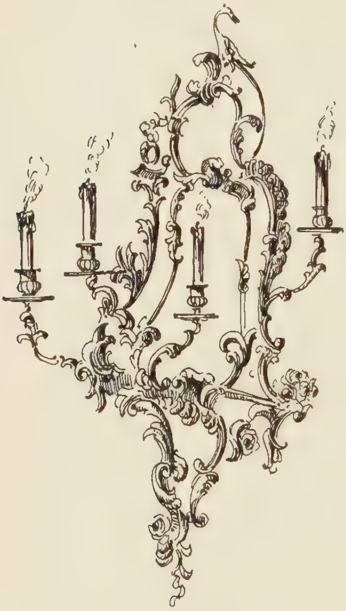

Fig. 58.—Chippendale.

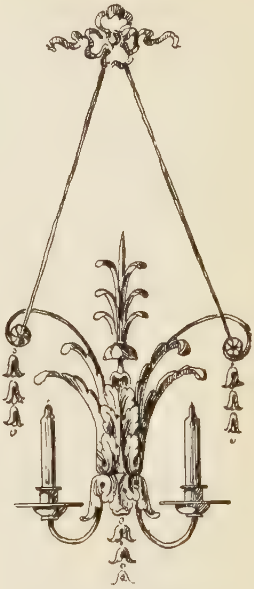

Fig. 59.—Hepplewhite.

We remember these periods more through the creations of certain interior decorators and furniture designers. Chippendale is well known for his furniture. He continued the use of the cabriole chair leg and splat back. Eventually, Chippendale evolved the square-back chair and introduced the square leg about 1750. Mahogany was introduced in 1730. Walnut was the vogue from 1650 to 1700 and, of course, oak had long been used in England. (See Fig. 58.)

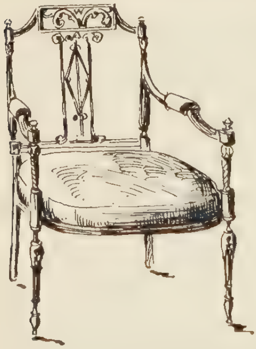

Fig. 60.—Sheraton.

Hepplewhite (Fig. 59) introduced wreaths and classic details in a sort of fantastic elegance. The oval or shield back was characteristic of his chairs. The legs were usually square.

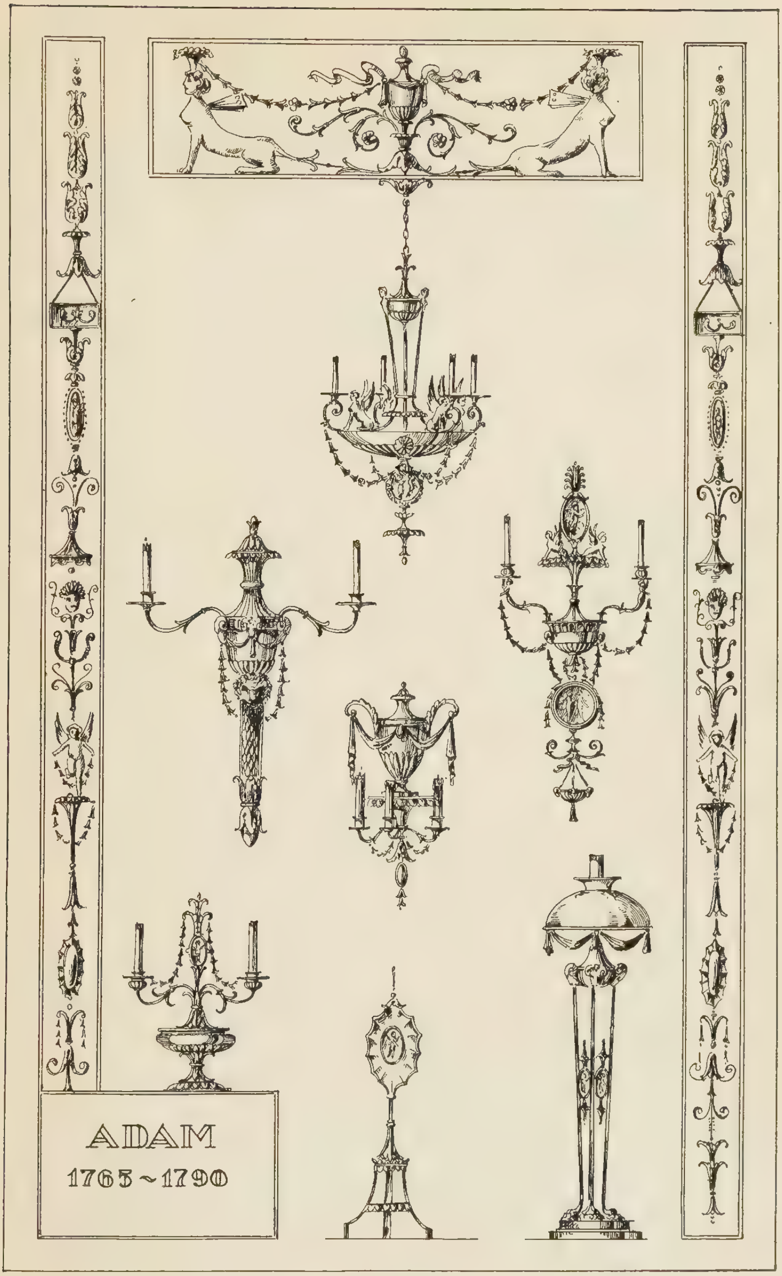

Fig. 61.

Sheraton furniture (Fig. 60) was characterized by straight lines and to some extent by painted designs. The chair legs suggest the Louis XVI style. He used fluted legs, twisted pillars, husks, festoons, and cornucopias. He as well as other furniture designers invented various articles of furniture and ingenious accessories.

The most famous of the artists of the Georgian period were the four Adam brothers of the Late Georgian. They were particularly influential in interior decoration and furniture. Throughout the Georgian period there was a tendency toward refinement and classicism, and the Adam brothers represent the culmination of classic revival. Robert Adam studied the excavated relics of Grecian and Roman art in Italy and brought renewed inspiration. Adam ornament consisted of a free treatment of classic architectural details, but with a strong tendency toward delicacy. The plaster ornament consisted of delicate moldings, scrolls, festoons, wreaths, etc., quite suggesting Roman relief. The Adam style (Fig. 61) is not necessarily English Renaissance. It may be considered to belong to the Modern Age, but it is included here for convenience.

During the Georgian period silverwork, ceramics (particularly Wedgwood pottery), and furniture developed very creditably.

It is interesting to note that the lamp chimney was invented in 1783. This was a great improvement in artificial lighting.

COLONIAL

(1720 to 1820 A.D.)

The early colonists did not possess the wealth to demand the production of elaborate art. They came to America to find a home in the wilderness. The furniture and the taste which they brought with them, naturally, were those of their home lands. English, Dutch, and French art were transplanted. The artists and the craftsmen who came from England were of the Queen Anne and Georgian schools. Lack of wealth and primitive conditions, naturally, resulted in frugality and modesty. At least, these conditions kept our early Colonial works free from over-adornment. The result is almost always pleasing.

The windows, doors, doorways, cornices, and dormers were simple and of excellent composition. Carvings were refined. Early doorways were commonly flanked by pilasters supporting a simple pediment or entablature. Occasionally, the pediments were scrolled, as in early Georgian houses in England. Church steeples were of wood and of simple classicism, patterned after the English ones by Wren. Windows were square-headed, except some in dormers. Later fan windows appeared over the doors (Fig. 62) and narrow windows flanked the doors. The vase or urn was used as a finial on gate posts and gables. Balustrades were used on roofs. In all these, simple classic details were employed.

In the interiors, paneling was common. Chimney-pieces consisted of pilasters or columns supporting the mantel shelf. In the better houses of Virginia and Maryland richly carved moldings of acanthus and egg-and-dart motifs were used. The interior cornices were quite elaborate. The Ionic and Doric orders were used, more or less modified. The Corinthian was seldom employed. Balustrades for stairways consisted of three slender spindles for each step. The spiral spindle and the newel post were introduced about 1750.

The Adam and Louis XVI styles gradually became influential and resulted in a greater artistic freedom without sacrificing delicacy and refinement. In Florida and California, where the Spanish settled, the art of Spanish Renaissance was introduced.

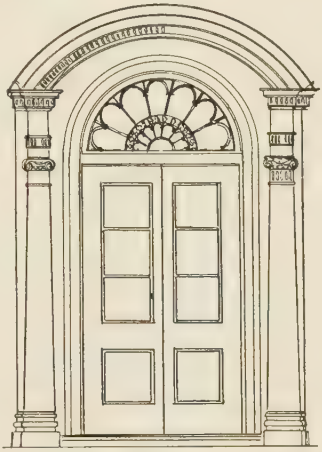

Fig. 62.—Colonial doorway.

It was not until after the Revolutionary war that the lamp chimney was invented (1783). Until this time the light source was the same throughout the ages—an open flame. The fixtures (Fig. 63) were determined by obvious requirements. The form, from a decorative viewpoint, could be anything desired within the limitations of open, smoky flames. The lamp chimney made some improvements or changes possible, but these were of little moment. A century was to elapse before a completely enclosed light source, which operated in any position, appeared. This light source greatly extended the possibilities of fixture design. (See Fig. 80.)

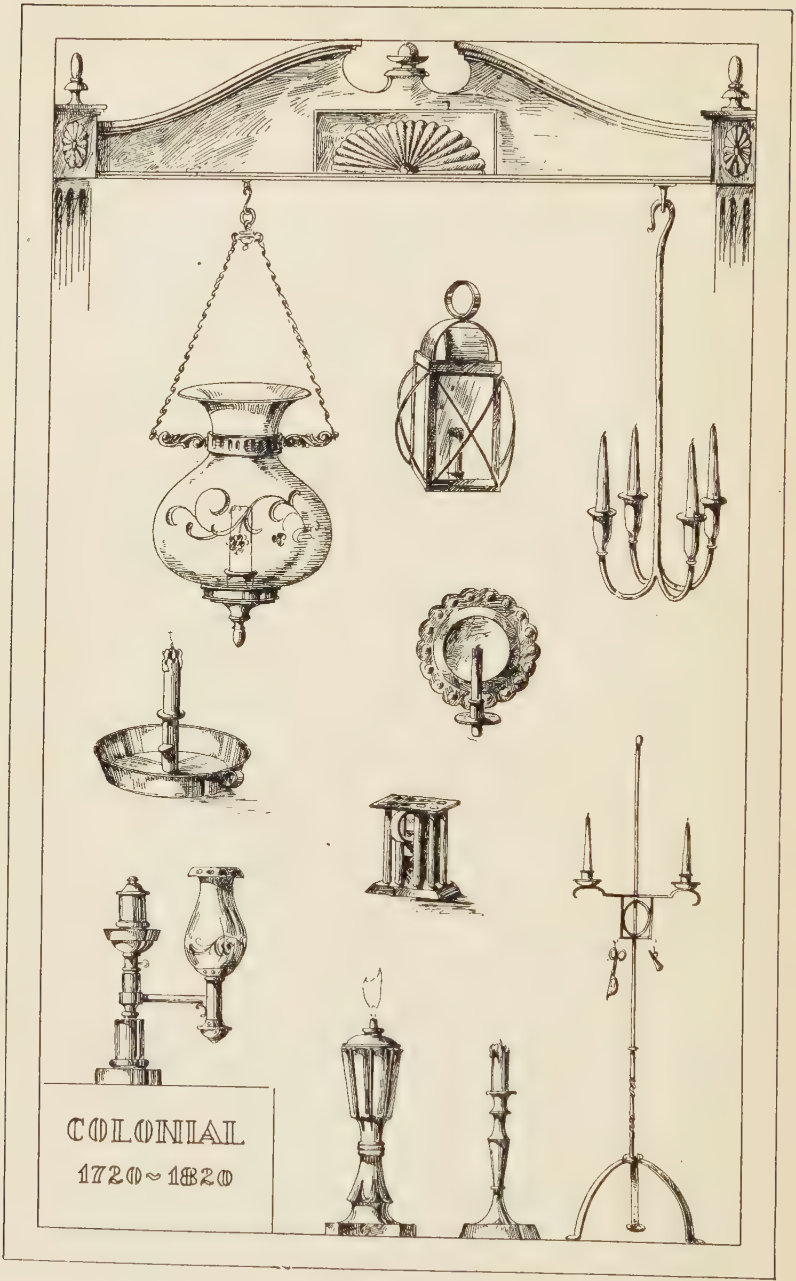

Fig. 63.

CHAPTER XIII

THE EVOLUTION OF FIXTURES

Many designers have clung dogmatically to the fixtures of the past without modifying them to suit best the new requirements and possibilities of lighting. They may suggest that a fixture is meaningless if it is not a copy of one of our heritages of past centuries, and as an object of art they may not even deign to consider it. Such an attitude is that of an imitator, and certainly is not one which creates and keeps up with the parade of civilized progress. As worshippers of much of the art of the past, we sympathize with them. As dogmatic imitators of the creditable objects of the past, we deplore their lack of appreciation of the fact that art and its products are ever evolving, owing to adaptation to new conditions. Certainly, an object or a building or its ornamentation is lifeless if it is merely copied with accuracy. No art of the past, however wonderful, is suitable to a later period without adaptation to the new order of intellectual, social, and economic life. Besides these inevitable changes in conditions, we have enjoyed in the past century great scientific progress, which, in the case of artificial light, has greatly increased the possibilities of lighting. One who reproduces a fixture from the age of candles, for example, without adapting it to meet modern requirements is not a designer. He performs an act no more complex than handing over an imitation of a former creation to a mechanic who replaces the candles with sockets. Still a survey of so-called artistic lighting fixtures shows that this is about all that has been done by many of the so-called designers and, unfortunately, the imitation is often made without refinement of taste.

In previous chapters we have had glimpses of the evolution of art. They have been included for several reasons, but one of the most important is to show that art is ever in a state of flux. If every person after the fall of the Roman Empire had said that art of the past must be copied slavishly and without license and that every object which was not a true image of a predecessor was meaningless, we would not have had the wonderful Gothic cathedrals, the magnificent products of the Renaissance, or any other heritages which have been created since Rome fell. The great artists of the Middle Ages and the Renaissance were not slaves. On the contrary, they were progressives who chose what was suitable from the past, used it with artistic freedom, combined with it the creations of their own refined and spirited taste, and produced something adapted to the new conditions. Art styles are due to progressive artists of spirit and not to those who copy without thought and feeling. The former are analogous to painters, the latter merely squeeze the bulb on the camera. It is true that an artistic creation or an art style is not always better than a preceding one, but sometimes it is. An artistic imitation is always poorer than its model.

The foregoing discussion is applicable alike to an individual object, to an interior, or to a building. Therefore, it applies to all artists and craftsmen who would imitate without adapting. It is the object of this chapter to discuss the evolution of lighting fixtures, but some brief comments on interiors are not amiss. Let us picture in our minds an interior of so-called Early English style. Such surroundings are delightfully reminiscent of a romantic past. There is a charm about them which well repays the cost and the effort to reproduce them. But let us see just how consistently they have been reproduced.

The timbered ceiling, the rough plaster, and various other characteristics are more or less faithfully executed. The lighting fixtures are produced true in form, but, behold, electric-filament lamps have replaced the candles. Here is a departure, because modern civilization demands modern light sources. But, apparently, in order to be as slavish as possible to the dead past, no shades have been used. Shades were practically unknown in the period which is represented, but electric lamps did not even exist. Furthermore, the extreme brilliance of the electric filaments and much greater candlepower demand that the light sources be shaded from the viewpoint of eye comfort and conservation of vision. Even if the interior were considered with artistic feeling, the shades would be applied to reduce the harshness of the lighting effect, for harshness is not compatible with artistic charm. Finally, the shades conceal the modern light sources and aid in producing the illusion of an Early English interior. But the slavish artist may object to such subterfuge.

He may insist that art must be frank and honest. It is true that gross trickery may not be justifiable, but art is replete with illusions, concealments, and expediencies. A painting is an attempt at an illusion. Artistic trickery abounds everywhere and it represents cleverness and ingenuity. This chimney and that fireplace are partially frauds. This plaster finish and that beam are deceptions. This line and that mass are cleverly introduced for a purpose which will not bear close inquiry by those misguided individuals who think that deception is not a legitimate and perpetual practice in art. But let us take a peep under that window seat. Behold, we find a radiator concealed. Such a device was unknown during the period reproduced. Furthermore, this rank modern object was concealed. Sometimes it stands brazenly in view in this so-called Early English interior. It is there because of progress.

We open a door and behold a bathtub and other conveniences demanded by our civilization. Everywhere we find modern devices which were unknown a century ago. In the face of these, the slavish imitator must admit that he is inconsistent. When the designer fails to adapt lighting fixtures of the past to the requirements and possibilities of the present, we need only to confront him with these modern practices to illustrate that architecture, decoration, and furnishing are undergoing changes now as they have been throughout the centuries. The successful design of an object, of an interior, or of a building is always the result of compromises of many factors, such as materials, comfort, climate, cost, usefulness, appearance, tastes, possibilities, and requirements. Let us now return to the consideration of the evolution of lighting fixtures and glean what we may in support of progress in design toward a greater realization of present possibilities.

PRIMITIVE LIGHT SOURCES

The crude light sources of primitive man are of interest to us only as background. The same material which was burned to obtain fire for heat was also burned to obtain light. In fact, light was merely a by-product of fire. The awe which was inspired by the sun and by fire took deep root in the minds of the early beings and, as their intellects developed, a feeling of reverence was nourished. By such a process early civilizations became worshippers of fire, of light, and of the sun. The natural and acquired attributes of the sources of heat and light became intricately woven into the thoughts, beliefs, and ceremonies of those prehistoric periods. These symbolisms have been handed down from one civilization to another until we find ourselves using them in many ways.

The winged disk was a familiar royal symbol of the Egyptians. The disk, representing the sun and its blessings, was flanked by the spread wings of the vulture and was supported by an asp on each side. This symbol represented the power and superiority of royalty. The flaming torch became the symbol of intelligence and even of victory. The attributes of light, fire, and the sun are symbolized in ornament by conventionalized rays radiating from the center of a circular disk or a half disk, the latter representing the rising or setting sun. Although the flaming torch, the splinter holder, and the metal basket supporting burning charcoal and fagots are of little value to us except as background, they represent a stage through which the development of lighting devices had to pass (see Figs. 16, 17, 18, and 19).

One of the first improvements in artificial lighting was the building of fires on ledges in the walls of the primitive homes of our early ancestors. The fire on the floor level was disadvantageous, owing to the direction of the light and the huge shadows which spread over walls and ceilings. With the light source raised a few feet, the advantage from a lighting viewpoint is obvious. Thus, there has been a tendency to raise the light source. Even in later devices, this tendency is evident. The candlestick evolved into a pedestal, which placed the light source at or above the eye level. The wall bracket and the fixture hanging from the ceiling are the result of the advantage of a light source at a high level and out of the way.

EARLY OIL LAMPS

We have no way of ascertaining how long primitive man was acquainted with fire before he discovered that some materials were more satisfactory than others for producing light. Possibly, centuries elapsed before the primitive intellects were capable of much in the way of selection and invention. Nevertheless, selection eventually took place. Pitchy and oily vegetable matter was eventually used instead of anything that happened to burn. Doubtless, the ready burning of the fat which dripped into the fire, led to the invention of the primitive oil lamp. At first the raw fat was burned in a receptacle, just as the Eskimo burns seal blubber today.

Perhaps the next step was to refine the crude natural products, with the result that animal and vegetable oils were obtained. Then the wick was introduced, just as the Eskimo today uses dried moss in his seal-oil lamp. These steps represent long periods of time in our early civilization. Oil lamps were first made of any convenient natural receptacle, such as human skulls and cup-shaped stones. In the Stone Age, stones were fashioned to suit the requirements and such relics have been unearthed which were used several thousand years before the Christian era. When civilization advanced to the point of clay working, oil lamps were modeled from clay and the plasticity of this material resulted in many forms (see Figs. 16, 19, and 29).

The fundamental form of antique oil lamps was a combination container and pourer. The Egyptians at least added handles to their oil lamps and provided funnels for filling. The early crude forms were also provided with a spout in which was an opening for the wick. These were plastically decorated and also painted.

METAL OIL LAMPS

When civilization reached the stage of real skill in metal working, oil lamps were made of bronze. The Greek and Roman lamps were quite flattened and the attached funnel ended in a simple orifice for the wick. The covers were hinged and various refinements, such as wick trimmers, were supplied. Owing to a desire for more light, some lamps were supplied with more than one wick. The lamps were placed on articles of furniture and shelves. Later, special pedestals were made for them and, finally, the beautiful tripods of Grecian and Roman craftsmanship were developed (see Figs. 29 and 30). This decoration depended upon the period. Some of those of the classic period are exquisite, with conventional ornament. Others are of freer forms, including animals and human figures.

As time progressed, various improvements were made which were due directly to a desire for better lighting. Multiple wicks provided more light. The heights of the lamps were adjusted by moving them up or down on pedestals. Next they were suspended from tripods, from a projection on the wall, or from the ceiling. Such oil lamps are in use today in backward or remote countries. Even in the highest civilizations they were in use during the nineteenth century.

In modern lighting they have no place. Even this lamp form has little application as a motif in fixture design. Some incongruities exist in the form of oil-lamp bodies in which an electric lamp has been inserted, but such an adaptation is scarcely justifiable. These forms offer some possibilities, however, where the spirit of antiquity is to be retained to the fullest extent. In such cases it seems that the form may be utilized best for concealing the actual lighting equipment, such as a lamp and a reflector, but such adaptations are very special cases and should be executed with the greatest caution.

Besides the antique boat lamp, other pendent lamps were in use even in antiquity. These were enclosures of pierced metal or open panels in which a candle or an oil lamp was placed. In the church these were the eternal lamps. The pendent mosque lamp consisted of a pierced metal enclosure, from the bottom of which projected one or more cups which contained oil. In later centuries, the pendent lamp assumed various forms, ranging from balls to paneled lanterns (see Figs. 19, 33, 36, 42, 44, 49, and 50).

TRIPODS

Antique tripods have a wide application in certain classic interiors. They may be used to support modern lighting equipment, such as alabaster, glass, or metal bowls of proper classic form and decoration. There can be no more serious objection to such usage than to many other adaptations of art forms of past periods. In fact, the use of tripods, just as the electrification of chandeliers of the Renaissance period, represents an excellent solution of modern lighting in interiors whose spirit is taken from the past (see Figs. 29 and 30). The top of the tripod was a deep bowl, a shallow dish, or a flat plate. By no means was the antique tripod only a stand with a flat top on which the oil lamp was placed. It was used in religious ceremonies to support the sacrificial pans containing the offerings to the dieties. It was also used in the home for many purposes, such as a support for basins, wine coolers, and ornaments, and even as a tray for visiting cards.

The classic tripod usually was made of bronze, but the monumental ones in civic use were sometimes of marble. The

Greek, Etruscan, Pompeian, and Roman tripods had legs which usually terminated in animal feet. Sometimes the top terminated in a ring in which a dish could be supported. Handles were sometimes included, so that they might be carried. The tripod may solve difficult lighting problems, particularly where chandeliers and wall fixtures are not expedient nor compatible with the spirit of the interior. If we follow the evolution of the tripod and its uses, we have an excellent example of an object or art form adapted from one use to another as the course and activities of civilization were altered. Certainly, we are as justified in adapting it to modern lighting as our ancestors were in modifying its usage.

CANDELABRA

Candles were in use in very early and perhaps prehistoric times. Doubtless, they were crude and not far removed from the torch or pitch pan. If the early candles had been of the refinement of the wax and even of tallow candles of the Christian era, it does not seem likely that they would have been completely eclipsed by the antique oil lamp. The fact is that the candle yielded to the oil lamp in Egypt, in early Greece, and even in Classic Rome. Oil lamps containing the monogram of Christ have been found in the catacombs of Rome, indicating that even the early Christians made and used them. The candle was used in ceremonies, and after the fall of Rome it became very conspicuous in the rituals of the Christian religion. With the progress of Christianity, the use of candles increased and, perhaps, we may assume that this revival in secular usage during the Middle Ages, the Renaissance, and in modern times was due to its importance in Christian rituals.

In the candelabrum we have another example of adaptation, for this stately device evolved from the tripod or lamp stand of antiquity. It was revived in the early Renaissance, along with classic art. Instead of the flat top or bowl top, a pricket or spike was used, upon which the candle was stuck. Sometimes a socket was devised for holding the candle. The candelabrum of ancient times had been modified to support the antique oil lamp and thus became a lamp stand which was in common use for centuries while the original candelabrum was forgotten except in rituals. Therefore, we have the candelabrum with a pricket, socket, bowl, flat disk, clip, or hook, depending upon its use as a support for a candle or an oil lamp. Candelabra were made of various materials and were finished in a variety of ways. The great candelabra for state and religious purposes were sometimes of marble and were surmounted by marble bowls. Smaller ones were made of bronze and other metals and also of carved wood decorated with paint and gilt. The design and ornamentation varied widely. The adaptation of these standards is quite justifiable for many modern lighting purposes (see Figs. 37, 41, 42, 47, and 48).

Massive candelabra of bronze, silver, and gold have been used in the pagan temples of the Far East, in the mosques of Mohammed, as well as in Christian churches. The Bible records the great golden candelabrum (Fig. 64) of the Jewish ritual. It consisted of seven arms, containing as many candles which were never extinguished, and signified completeness and the presence of Jehovah. Thus, the candelabrum has been associated with various religions and peoples. These precedents make this type of fixture appropriate for modern lighting in many interiors of early periods. Some of the candelabra were of very great size, so that they are appropriate pedestals for modern lighting in large interiors. They were often used in pairs, and this practice has been handed down to us even in small candlesticks.

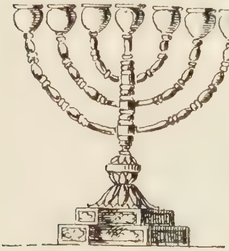

Fig. 64.—Celebrated Jewish candelabrum.

CANDLESTICKS

If any distinction between candelabra and candlesticks may be made, it is in the matter of size. The candelabrum could be moved, but it was not meant to be carried about. The candlestick in some form or other has been in use from the time of the earliest crude candles. Doubtless, the candle evolved from the rush light or a similar crude light source. The pitch of rushes was soaked in oil and it burned well. Pitch was rolled in a coating of leaves or other dry vegetable matter, and a crude "candle" with the wick outside the fuel was the result.

The candlestick of small size and simple form, as we think of it, was the candle bearer of the Middle Ages and the Renaissance and, of course, is in use today. It varied greatly in size and form, depending upon the purse and the requirements. Where our early colonists in their frugality were satisfied with crossed wooden sticks to hold the candle, the aristocrats of the Renaissance possessed candlesticks of exquisite design and costly material (Figs. 37, 41, 42, 44, 45, 47, 48, 61, and 63).

During the Middle Ages the candle was usually stuck on a pricket, but later the socket became more popular. The upper end of the shaft often contained a saucer or "save-all" for catching the drippings. Sometimes this saucer was removable, so as to facilitate cleaning. Even these candlesticks for secular use were sometimes branched, so that from one to seven arms are found on them. Tall ones of wrought iron were common in the Middle Ages. The Chinese and Japanese candlesticks of bronze were somewhat suggestive of the Romanesque bronze ones used in the churches.

The candlestick is a perfectly logical pedestal for an electric lamp and no successful argument can be mustered against such an adaptation. Of course, the entire "electrified candle," including the shade, must be harmonious in form and materials. Here again, we have an example of the desirability of proper shades for concealing the modern light source and, therefore, in aiding the illusion. The harsh lighting effect, the ocular discomfort, and the brazen incongruity of an unshaded electric lamp surmounting a candlestick demand the use of shades. Parchment, mica, and silk are popular, although certain finishes on glass shades make glassware acceptable. The cut glass or etched crystal glass common a century ago do not diffuse the light from modern sources sufficiently for comfort. In large rooms where we do not linger, the sparkling effects of such glassware is sometimes admissable and even desirable, but too often they are offensive to one who desires restfulness and comfort.

CANDLE BRACKETS

A logical step in the evolution of lighting fixtures was the bracket for supporting the torch or candle on the wall. The form is necessarily quite different from the upright candelabrum and candlestick. The bracket projected from the wall or other vertical support and ornamental structural work was naturally introduced. These have been usually of metal, although some exquisite carved-wood brackets were produced during the Renaissance. Crude brackets were hung on a hook or nailhead, but rosettes, wall plates, and cartouches were used for the more elaborate ones. The bracket could support as many candles as were desired, so that more than one arm was common in the wall brackets of pretentious interiors. Three arms were common during the Renaissance and the three sockets or prickets were sometimes grouped artistically at different heights. Crude mirrors of polished brass were sometimes used as a part of the fixture next to the wall in the early Renaissance. Later, polished silver and glass mirrors were used, but not extensively. The candle bracket became a beautiful object during the Renaissance and, in fact, throughout its use in various countries it assumed many forms and was decorated in accordance with the prevailing style. Doubtless the bracket, in crude form at least, was in use in ancient periods, but it came into prominence during the revival of the candle in the Middle Ages (see Figs. 41, 44, 45, 47, 48, 50, 58, 59, and 61).

The modern adaptation of the bracket fills many utilitarian as well as artistic requirements. Modern lighting does not place any appreciable restrictions upon artistic design. Any art style may be carried out, but here again the absence of shades is deplorable. Shades conceal the electric lamp and make the lighting effect charming and comfortable. The designer who is satisfied with the harsh and uncomfortable lighting as well as the exposed incongruity of a candle form surmounted by a foreign element such as a lamp bulb is lacking in refinement of taste or in ingenuity to adapt a shade to the electrified candle. From every viewpoint, the absence of shades in most cases is indefensible.

CHANDELIERS

In the Middle Ages candles (and also oil lamps to some extent) were placed in a ring and suspended from the ceiling. The light sources were in the same plane, as was necessarily also the case in the multiple-wick oil lamp. During the Renaissance, the chandelier became highly developed in a variety of forms and in richness of ornamentation. The light sources were arranged in more than one ring, and eventually in tiers. When the chandeliers were finished in glittering metals and glass crystals, the many candles and their many reflected images produced a beautiful effect of glittering splendor. But it should be noted that the candle flame was of harmless brightness, so that shades were not urgently needed, as they are with modern light sources of much greater brightness and candlepower. Furthermore, the flickering flame was likely to set fire to the shades if the latter were inflammable.

For the foregoing reasons, shades were not common where candles were used. Is the fixture designer of the present time omitting shades because the prototypes from the candle ages did not have them? Surely, this does not justify the resultant harshness and discomfort from electrified chandeliers without shades. In large rooms, such as ballrooms, sometimes the absence of shades is permissible. Certainly, delicate shades which conceal the electric lamps and diffuse the light do not depreciate the chandelier as an attractive fixture. In fact, the beauty of the lighted chandelier is better seen and appreciated when the light sources are shaded. Here we have an adaptation which is not only necessary, but also desirable. One of the deplorable facts of fixture design is the confinement of attention to the drawing and the executed object. The designer should visualize the *lighted* fixture all the time. Such a procedure will prevent much misuse of light and also abuse of the eyes and of the esthetic sense (see Figs. 29, 37, 41, 42, 44, 45, 47, 48, 50, 51, 61, and 63).

The chandelier may be one of the most beautiful fixtures which it is possible to design, but modern lighting possibilities should be taken into consideration in its design. In its depths equipment may be concealed which makes it possible for us to enjoy greater control of light than the chandelier alone provides. Some of these suggestions are presented in later chapters. Through an understanding of light control, ingenious adaptations may be made by the designer who would be more than a slavish imitator. Adaptation is the watchword of all creative art, as well as of progress in general. With modern electric-filament lamps the designer need not allow for smoke, for upright burning, and for fire hazard, as in the ages of candles. Furthermore, interiors, however pure in art style, have many modern touches which aid in justifying the electric lamp and certain modern lighting possibilities. With a full appreciation of his function, the ingenious designer will produce for a Louis XIV ballroom chandeliers which that fastidious king, for whom the style was named, would have envied. In looking back at other periods, we should bear in mind that the artists of those periods would have reveled in the potentiality of our artificial light if they had had it at their disposal. All we need is the ingenuity to adapt modern lighting possibilities without offending progressive taste. The taste of the slave is of little consequence.

CENSERS

From those old ecclesiastical utensils called censers, incense arose, and with it a prayer to heaven. Censers were made of pierced metal, such as silver, bronze, brass, copper, and iron. A fire pan in the bottom contained the burning material. The censer was supported usually by three chains. Naturally, the decoration was often symbolic and usually ecclesiastical. Although these were not used for lighting purposes, by their associations they provide excellent motifs for lighting fixtures in churches of the appropriate style. Owing to the construction of openwork metal, they are not efficient lighting fixtures, but their appropriateness makes up for this deficiency. Furthermore, they may be better adapted for lighting by making the metal work more open than in the originals and by opening the top and the bottom completely. In fact, the top and the bottom may be open or covered with glass. Much can be done with this heritage of the past to make it a practicable lighting fixture without losing the character of the motif itself (see Figs. 37, 41, 126, and 127).

VASES

Vases and their many relatives have been in use throughout the ages. Their varieties in form and in usage supply various motifs for modern art. There is no record of any of the receptacles being used for lighting purposes in earlier centuries, except as bowls and shallow dishes surmounted lamp stands and candelabra and contained oil lamps or candles. Doubtless, such receptacles were sometimes used for this purpose without the special support. After the chimney was invented for the modern oil lamp, the vase form became a motif for its design as well as for glass shades. Either vase forms or the sources which inspired them have been inspirations in the design of many standards, including legs of tables and other articles of furniture, lamp pedestals, pillars, and other architectural details, such as finials.

In recent years vase forms have been used more or less successfully for pedestals of portable lamps. It is true that some of them are ugly and incongruous, but this is due to the lack of taste and not to any fundamental deficiency or defect in vase forms. Still, some condemn the practice as being untrue to tradition, but, as in other cases, we find parallels which encourage our support of the practice of adaptability. For example, the Doric or the Corinthian column was developed to support an entablature—a real load. Perhaps those progressive artists of past centuries who first used the column as a motif in the decoration of articles of furniture, of picture frames, etc., were criticized as violators of tradition. However, the criticisms were doubtless not effective, because they came primarily, as now, from imitators who had not learned that the greatest tradition in art is that progress is made by adaptation of the old to the new. Of course, common sense, imagination, restraint, and refinement in taste are the guiding influences. Here we are merely stating principles and possibilities; we are not defending the incongruities perpetrated by the unfit.

Let us take a further step and consider the vase and its relatives, such as the urn, amphora, ampulla, jar, and bowl, as lighting fixtures for the concealment of modern equipment. Some view with horror such a usage for a Grecian vase, but the Greeks had no monopoly on the usage of the vase form. Doubtless, they would have grasped with great joy the opportunity to use them as we would now to shower upward a sufficient amount of light to reveal the beauty of their work. Vase forms have many uses in modern lighting. The forms to be adapted to lighting should be the stable ones, and this generally means the symmetrical ones. These forms for lamp pedestals and for indirect lighting should not only be stable for practical reasons, but should appear stable. The latter requirement has generally ruled out the asymmetric pitcher and the antique oil lamp as a motif. Of course, symmetry is not so essential if the vase form is fastened to the wall. The use of the vase for concealing lighting equipment is appealing to the lighting specialist because it solves many lighting problems in a very satisfactory manner. The vase may be translucent or opaque, depending upon the conditions to be satisfied (see Figs. 19, 26, 28, 40, 42, 48, and 140).

In the choice and use of vase forms for lighting fixtures one is only limited by his own knowledge, for civilized nations of all ages since prehistoric centuries have made pottery and many have carved these forms from stone. Even primitive peoples not included in civilization make crude pottery. Therefore, countless forms are available in any period style. Along the Nile in Egypt and along the coast of Scandinavia pottery has been excavated which is probably 10,000 years old. Paintings executed 4,000 years ago show that pottery was then in use in India and Mesopotamia. The earliest pottery was not intentionally colored, but when the coloring effect of iron oxide was discovered it was intentionally used. Iron oxide is usually responsible for the red color of fired pottery. The Greeks painted their pottery as early as 600 B.C. and this became a very creditable art before the Roman conquest. So much has been learned of the civilizations of antiquity from the pottery left behind that these relics are considered to be the most valuable historical "documents" possessed at the present time.

Geometrical forms are common in vases, although many natural motifs are found. Among the latter are eggs, horns, gourds, human figures, and animals. The decoration is characteristic of the period and race. Countless forms were employed for the great variety of vessels used in secular life and ecclesiastical rituals. Handles were usually vertical and, of course, in pairs. Horizontal handles were used chiefly on the low vessels.

The *amphora* was common even in ancient times. It was a receptacle for water and wine and, therefore, had handles. Later it came into use as an ornament. The *ampulla* is a diminutive vessel of this type.

The *urn* is distinguished by its relatively wide neck as compared with its height. It has been in use since prehistoric centuries in domestic life and in funeral rites. In the latter, it became the repository for the ashes of the dead. In form its body was commonly like an egg with its more pointed end downward. The base was either wide enough to be stable or contained feet. Of course, countless forms were utilized. When handles were provided, they were usually a pair of horizontal ones. The urn is often used purely as an ornament in interiors, in gardens, and finials in architecture.

The *krater* is a vase form from antiquity. It was used for mixing water and wine. Its body is bell-shaped or squat and has a wide neck. Sometimes it is a hemispherical or shallow dish surmounting a standard. It usually had two or more handles. State vessels of this character were usually of large size and were made of clay, metal, or marble. These are now used in the garden and elsewhere for containing growing plants.

The *font* or *stoup* (Fig. 40) for holy water in the Catholic church was formed like the krater and was commonly supported by a pedestal. Sometimes it was fastened to the wall.

The *cist* was usually a cylindrical metal vessel which was used in religious rituals and also as a container in secular life. The *hydria* was the water pot in which water was carried and stored. Basins, jars, and a great variety of receptacles are other utensils which eventually became very decorative objects and often pure ornaments. All these may be drawn upon in the consideration of modern lighting.

YESTERCENTURY

The metal oil lamp during the Renaissance began to vary from the boat form of the earlier lamps. Finally, a wick was used in a vertical or nearly vertical position. These were the early forms of oil lamps used in the American Colonies until after the Revolution. It seems strange that, throughout the great progress of civilization for eighteen centuries after the beginning of the Christian era, the flames of candles and of oil lamps were permitted to flicker. But this is true, for the lamp chimney was invented by Argand in 1783. This chimney was placed over the vertical wick and the flame not only steadied, but became brighter and ceased smoking. However, a lamp chimney was costly and represented a refinement which our frugal colonists could do without; therefore, the open-flame whale-oil lamp was used as late as 1850. Owing to the desire for more light, it was often supplied with twin wicks. About the midde of the nineteenth century, a mixture of turpentine and alcohol, termed *camphine*, was used, because it gave a brighter flame. Petroleum was discovered about this time, but some years elapsed before kerosene was available. Then the kerosene lamp arrived and it is still widely used.

Gas lighting was introduced at the beginning of the nineteenth century. The necessity of supplying the gas through pipes for the first time made lighting equipment "fixed" in position. How the unsatisfactory term *fixture* came into use is more or less obvious, but attempts to replace the term *lighting fixture* by other terms, particularly *luminaire*, have so far been unsuccessful. Therefore, the term *lighting fixture* is used here because it is the one commonly employed. The fish-tail gas flame was not much brighter than the candle flame, so there was little need for diffusing the light. When the electric-filament lamp appeared, it was naturally attached to the gas-lighting fixtures and the *combination* fixture appeared.

With the entrance of gas and electricity into lighting, the mechanic became an important factor. Candle brackets could be executed entirely by artists and, as a consequence, they were commonly artistic products. But gas lighting was a job for the plumber, just as electric lighting required the electrician. The artist now shared the field with mechanics and in most cases apparently was crowded out, if we are to accept as evidence the many hideous combination fixtures which are still in use. With the recession of the great artistic wave which we know as the Renaissance, creative art lapsed. Furthermore, scientific progress gained attention at the expense of artistic progress. Lighting fixtures showed the influences of these conditions, and few creative artists have continued in the field. We need a "period style of electricity" in lighting fixtures, but it will never be developed by slavish imitators.

Some critics condemn the practice of using drip pans on electric chandeliers containing imitation candles—white or ivory cylinders surmounted by electric lamps. They also denounce the lighting fixture fashioned after the Colonial style because it consists of a metal bowl, imitating an oil container, which is surmounted by a shade surrounding an electric lamp. These practices are justifiable, however, because the candle and the oil lamp are motifs. If we study objects of any century, we find such non-utilitarian accessories. These are the necessary by-products of adaptation of old motifs to new objects. But adaptation is acceptable only when it is done well, and this cannot be said of fixtures which have no shades for the shallow reason that candles did not. The same is true of the use of crystal-glass shades from the Colonial period. These were fairly satisfactory with the flames of low brightness, but at the present time they do not sufficiently diffuse the light from our exceedingly bright electric filaments.

We have as much right to use any object of the past as a motif for a modern decorative form or ornamentation as Hepplewhite had to use a shield as a motif for his chair backs. Art not only creates purely conventional form and utilizes natural forms, but it also uses artificial forms of the past. The artist has great freedom in this respect, but his freedom is not justified if it transgresses the laws of harmony and causes visual discomfort and injury to the eyes. Certainly, a glaring lighting fixture is not artistic. In grafting new things to old ones or old ideas to new ones, harmony in its broadest sense should be the goal. Harmony in lighting fixtures means perfect adaptability of form and details to produce the desired lighting effect and to please the eye artistically and ophthalmologically. The great number of modern lighting fixtures which cause ocular discomfort condemn the so-called fixture designer as being indifferent, negligent, and perhaps ignorant of the principles of proper lighting. The great number of modern lighting fixtures which reproduce only the meager lighting possibilities of light sources of the past, instead of providing some of the greater possibilities of electric lighting, testify to the negligence or ignorance of the designer in respect to the great potentiality of modern lighting. In many interiors lighting fixtures of the past can and should be adapted by only slight modifications. However, in some of these interiors and in most others, additional lighting effects can and should be provided for. Much can be done in fixtures without causing them to be unacceptable in our period interiors.

A great suspended indirect-lighting fixture was never used by the Romans in their classic interiors but this is not a justifiable reason why such a fixture cannot be used at the present time in an interior of classic Roman spirit, provided the lighting effect is desirable. What would the Romans have done with our possibilities in lighting? If the fixture is formed and decorated properly, who can say that it is incongruous? If it is, the Roman style has not been properly adapted. As has been stated before, if we adopt the same narrow unprogressive attitude toward every other detail, we will have nothing but an imitation of a Roman interior. It is certain that, in our bank buildings and other structures, classic architecture or any other period style would cease to be used if it could not be adapted to the present conveniences and possibilities. If the absence of modern lighting possibilities is defensible, we might just as well demand that the cashier of a bank decorated in classic Roman spirit be arrayed in sandals and toga.

The same idea may be extended to all interiors which are constructed and decorated in the spirit of a bygone period style. The achievements of artists buried centuries ago are valuable heritages and of historical interest, but many of them are of little value to us unless modified to suit the needs of a civilization of which they did not even dream.

CHAPTER XIV

REPLACING FLAMES WITH ELECTRIC LAMPS

When the electric-filament lamp appeared, the natural step in fixture design was to replace the flame light sources with these lamps. The electric lamps were quite free from fire hazard and they could be operated in any position. The smoke and the heat carried upward by air currents made it necessary to leave the space above the flames free or in some cases to provide a baffle above them. When shades were used at all, they were necessarily upright instead of pendent. Advantages in fixture construction must have been apparent immediately upon the advent of the electric-filament lamps. There were few restrictions, as had been the case with flames. They could be totally enclosed in diffusing media and, owing to their operation in any position, shades could be pendent or in any other position. Owing to the remote control by means of switches, it was practicable to construct and to install fixtures without having accessibility uppermost in mind. As many lamps as desired could be concealed in bowls, in large pendent shades, in high fixtures, and even in architectural details. A new era of possibilities was ushered in by the electric-filament lamp, which is not fully realized even now after the several decades since its arrival.

The most obvious step was to replace the older flame light sources by the new electric-filament lamps. This was a natural result of habit, but this habit is too persistent. It is true that many beautiful and very suitable fixtures have been made by the mere substitution of the new light sources for the old without any appreciable change in the design of the older fixtures except to provide for wiring and sockets. Such fixtures will always be necessary and acceptable in certain places in interiors possessing a spirit of the past. This practice has been extended too far, however, for it has inhibited the development of fixtures which aim to produce lighting effects which are now possible and which were undreamed of a half century ago. Electric-filament lamps opened up extensive possibilities in lighting effects because artificial light for the first time could be controlled as desired. They ushered in a new era in diffusion, shading, reflection, distribution, and color of light. The steadily increasing efficiency in light production since the invention of electric-filament lamp, upon which was superposed certain large increases in efficiency, such as those due to the tungsten vacuum and gas-filled lamps, has also continued to extend the possibilities since the beginning of the new era.

In other chapters the possibilities of modern lighting are discussed and suggestions are presented pertaining to fixtures and concealed equipment for obtaining lighting effects. This new era may be considered to be one of lighting effects rather than one of mere light sources. We need no longer give our attention merely to light sources supported by beautiful fixtures. Modern possibilities of the control of light produced with relatively great convenience and efficiency have made light a medium which may be handled in a variety of ways to produce utilitarian and artistic lighting effects.

However, in passing, let us consider some of the simple adaptations of electric lamps which are little more than substitutions of these modern lamps for the less convenient and relatively feeble flames. The provision for wiring and electrical outlets has limited the design of fixtures very little. Sometimes ingenuity is required, but this makes the work worth while. The only important limitation which the electric-filament lamp has introduced is the necessity for shading and diffusing the light. Except in large interiors, the absence of shades and of diffusing media which protect our eyes from these modern light sources of relatively great brilliance and soften the shadows is inexcusable. There is adequate proof that shades and diffusing media are necessary, and the designer or user of lighting fixtures who uses the modern substitutes for flames without providing the necessary shades or diffusers is negligent or ignorant of the principles of proper lighting.

As already stated, there are many uses for fixtures of past period styles in which electric lamps are substituted for the former flames. Therefore, this chapter is devoted to a discussion of these. The examples given are not exhaustive in number. They do scanty justice to the many beautiful fixtures of this kind which have been made. Furthermore, no attempt has been made to represent more than a few period styles. The primary function of this chapter is to emphasize this first step in the modulation of fixtures from the old régime of flames to the present one of electric filament lamps. In this presentation the necessity for shaded and diffused light is emphasized. No detailed discussion of the characteristics of the period styles is attempted, but it is hoped that those unfamiliar with or uncertain of these will be aided somewhat in acquiring a further idea of the spirit or the feeling of the various styles. In each case it may be helpful to turn back the pages to the brief account of the art of the period.

There are many who deplore the inefficiency of lighting fixtures in which efficiency of light control is subordinate to appearance. The author has no patience with this attitude except where efficient lighting equipment may be incorporated without sacrificing appearance. Obviously, little can be done in this direction in pure adaptations of earlier fixtures unless their form is such as to permit the introduction of the necessary equipment. On the other hand, many fixtures waste light needlessly, because of the lack of attention on the part of the designer to well-known laws of light and properties of reflecting and transmitting media. Waste due to such neglect is inexcusable. However, when we consider beautifying interiors and making them charming and expressive of a certain spirit or mood, efficiency, used in its narrow sense, is not the primary viewpoint. It is senseless to impose the limitations and crudities of efficiency on lighting any more than on furnishing. No one inquires into the efficiency of a decorative vase, of a picture on the wall, of draperies, or of articles of furniture. A room decorated and furnished with efficiency, as used in a narrow sense, uppermost in mind would not have beautiful rugs and silk draperies. It would be devoid of vases, pictures, and other decorative objects. The furniture would be crudely simple. It would be a proper place to confine those who cry for unreasonable efficiency until they learned that efficiency of lighting fixtures and of lighting effects, as with many other features of interiors, is the ratio of satisfactoriness to cost. It is not merely a matter of cost.

In this discussion of fixtures, in which the substitution of electric lamps for flames and the provision of shades or diffusers constitute the sole changes of importance, it seems necessary to consider only those period styles which have been predominantly used. Some of the fixtures of past periods find few places in modern interiors. Others are confined to churches and special interiors, which are discussed to better advantage in later chapters. The inspirations which underlie the architecture and the furnishing of most modern interiors arise in the art styles of the Renaissance. In many interiors we find that adaptation has resulted in a blending of influences of various period styles. These may differ greatly from a temporal viewpoint, just as the classic art of Greece and of Rome was blended into the Romanesque and finally into the various styles of the Renaissance. Perhaps more often the various influences or spirits which are detectable in a modern interior are traceable to more or less contemporaneous styles.

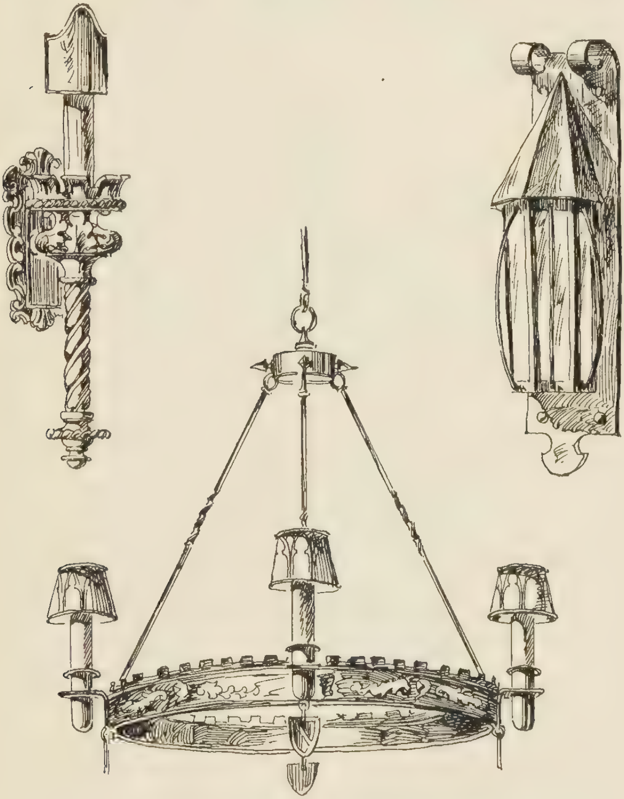

Fig. 65.—Early English.

The Early English interior is quite popular in residences at the present time. Naturally, this style often calls for wrought-iron fixtures, as illustrated in Fig. 65. Because these were not shaded when they contained candles, they are often unequipped with shades in our modern reproductions and adaptations. As has been stated many times, this is incompatible with comfortable and artistic lighting. Old parchment, appropriate textiles, and certain decorative glassware are quite suitable, although, of course, the form and the decoration of shades should be in harmony with the fixtures. A Tudor bracket is illustrated in Fig. 66. This is a phase of late Gothic or Early Elizabethan. The linen-fold motif is used and the pointed arch is suggested in the shields. Thus we see in these the lingering spirit of the Gothic style. The thistle, the battlement, and the Tudor rose are some of the motifs of modern fixtures adapted to this style.

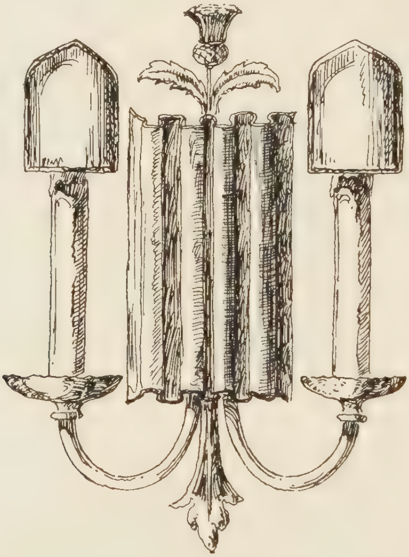

Fig. 66.—Tudor.

In the Early English interior reproduced at the present time there are many possibilities of introducing modern light control. The ironwork may be arranged so that, in addition to shaded electric candles, we may install a suitable dome for illuminating the dining room table, as suggested in later chapters. This idea could be incorporated in the German Renaissance fixture illustrated in Fig. 67 (see Chap. XVI). In a similar manner we may include a bowl for obtaining an indirect-lighting effect, in addition to the electric candles. It is true that this was not done in the actual fixtures of the period, but adaptation is the true function of the designer. However, these phases are reserved for other chapters.

A modern Elizabethan fixture is illustrated in Fig. 68. The spirit of the style is shown in the massiveness and heavy ornament. Heraldic motifs and strapwork are common in this style and old bronze, brass, and iron are appropriate. The massiveness of the Elizabethan architecture and ornament makes it easy to introduce bowls into these fixtures for obtaining indirect-lighting effects. In Fig. 68 a dense glass bowl is included along with the shaded electric candles. The bowl may be opaque or barely luminous. Such a fixture embodies the spirit of the Elizabethan style and provides some modern lighting possibilities (see Figs. 53, 54, 55, 99, 108, and 135).

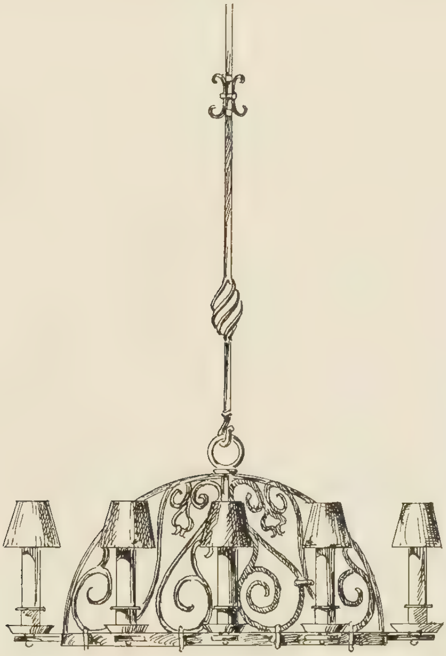

FIG. 67.—German Renaissance.

The Jacobean style is an outgrowth of the Elizabethan. Associated with it are twisted legs, straight-line effects, and pointed square knobs. The forms and ornament are still heavy, but not as massive in general as in the style which preceded it. Figure

69 illustrates a modern Jacobean chandelier. In both these styles the Italian spirit is reflected, but it is stabilized by the English temperament, which expressed itself in oak woodwork, paneled rooms, stuccoed ceilings, and hangings of tapestries, linens, and embroideries.

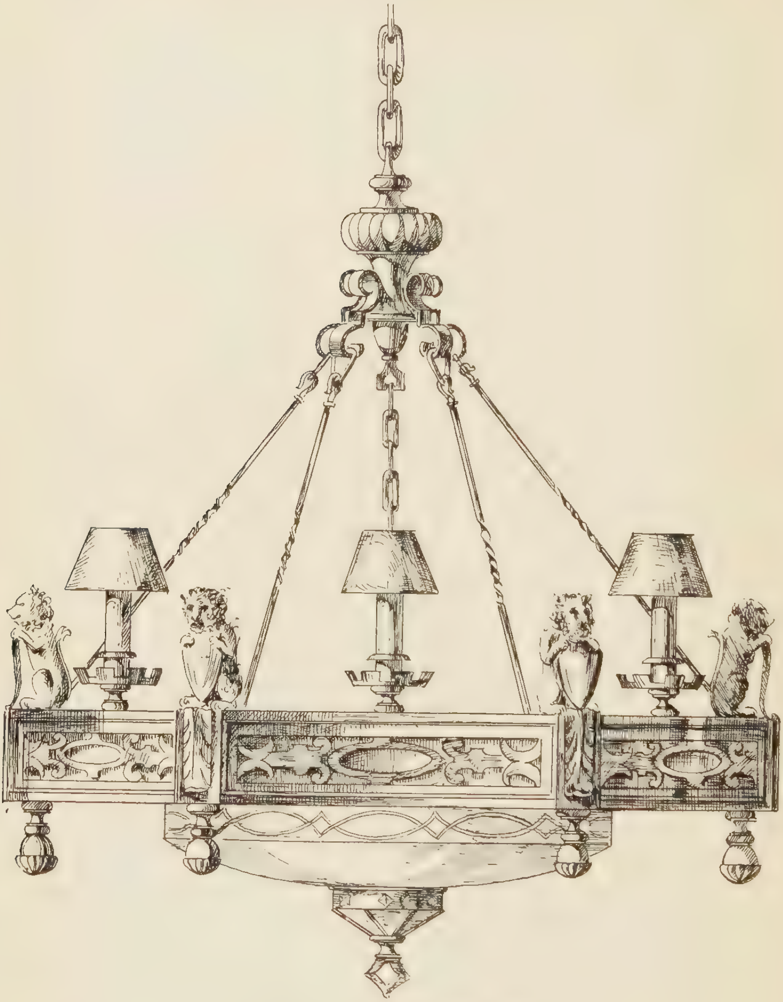

Fig. 68.—Modern Elizabethan.

A modern ballroom fixture of the English Renaissance spirit is illustrated in Fig. 151. The visored helmet, heraldic design, and the scroll leaf of the Elizabethan period are in evidence. Another modern adaptation of English feeling is illustrated in Fig. 97.

Owing to the proximity of the Netherlands and the friendly relations with them, the art of the English Renaissance was much influenced by the products of Flemish and Dutch artists. The Dutch were successful in commerce, but at home they struggled against Nature, reclaiming land from the sea and holding it at the cost of much effort. The stolid Dutchman was acquainted with the realities of life and his character is reflected in his art. Extravagance was naturally foreign to the life of Dutchmen, regardless of individual wealth. Figure 70 illustrates a modern adaptation of the Dutch chandelier. The spirit is that of simplicity, suggesting not exactly frugality, but rather thriftiness. Sweeping curved lines, turned spindles, and squat vase forms are characteristic, and the surfaces of these forms are commonly plain. Old brass and bronze are appropri-

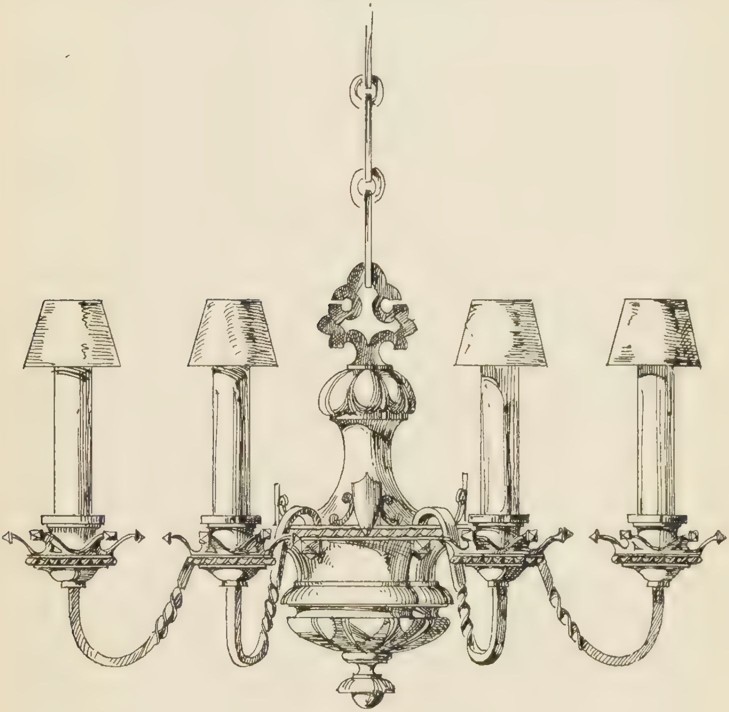

Fig. 69.—Modern Jacobean.

ate. Many Dutch chandeliers are beautiful; but their beauty relies on sweeping curves and plain surfaces rather than upon exquisite ornamentation.

The more common modern adaptations of Flemish fixtures resemble those of the Dutch. Perhaps more ornamentation of surface was practiced in Flanders than in the neighboring land which is now Holland. Some fixtures and ornamentation of the Flemish style are shown in Fig. 50. A modern adaptation of a Flemish bracket is illustrated in Fig. 71. Vase forms are common in the body and sweeping curves are prevalent. The metal work is commonly old bronze and brass. Adornment is quite appropriate for Flemish fixtures, but modern adaptations are often fairly plain of surface.

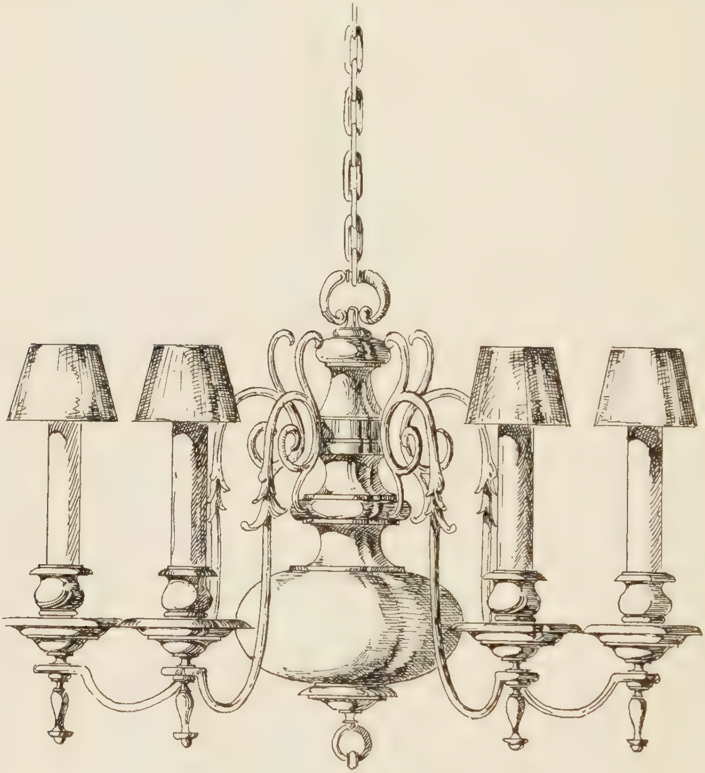

Fig. 70.—Modern Dutch.

The Georgian period extended over a century and during that time various styles and combinations of them evolved. In the

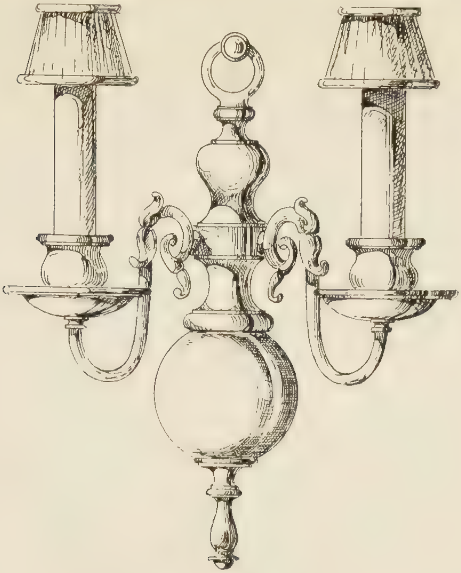

Fig. 71.—Modern Flemish.

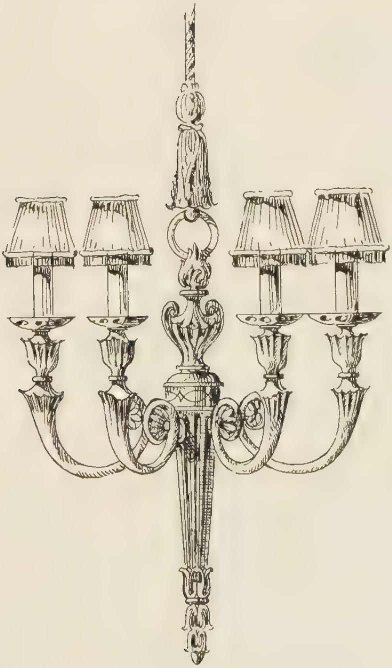

Fig. 72.—Modern Late Georgian.

early Georgian, Flemish and Dutch influences are evident, but throughout the English Renaissance the Italian influence is apparent. This influence came direct from Italy through visits of English artists and the importation of Italian craftsmen. English styles were also influenced by contemporaneous styles in adjacent France. In the middle Georgian, Chinese motifs were introduced to some extent. Toward the latter part of the Georgian period a classic feeling dominated English art.

A modern adaptation of a Georgian fixture of classic feeling is illustrated in Fig. 72. The classic motifs are apparent and the simple dignity of the fixture is characteristic of this classic revival.

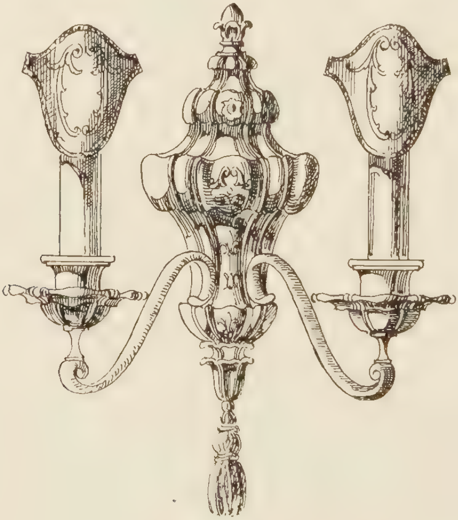

Fig. 73.—Modern English Sheffield.

In the middle of the eighteenth century Sheffield silverware was introduced. Sheffield was not an art style; it was a product, just as Wedgwood and Sèvres pottery were products. Artistically, these products are worthy of the approbation they received. Figure 73 illustrates a modern English fixture which is commonly termed Sheffield because of the spirit of Sheffield silver which is embodied in it.

The pronounced revival of classic art in the Adam style is well known and is illustrated in Fig. 74. The fine classic details, such as ribbons, medallions, wreaths, festoons, buds, and Greek figures, are characteristic of this style. The Adam brothers were famed as interior decorators and many fine examples of their work are in existence (see Fig. 61). Their fixtures which were made for candles are readily adapted to modern interiors of the same period by using electric candles equipped with shades. Certainly, the shades illustrated in Fig. 74 do not depreciate the beauty of the fixture. By obscuring the electric lamp, they make the illusion more complete and temper the lighting.

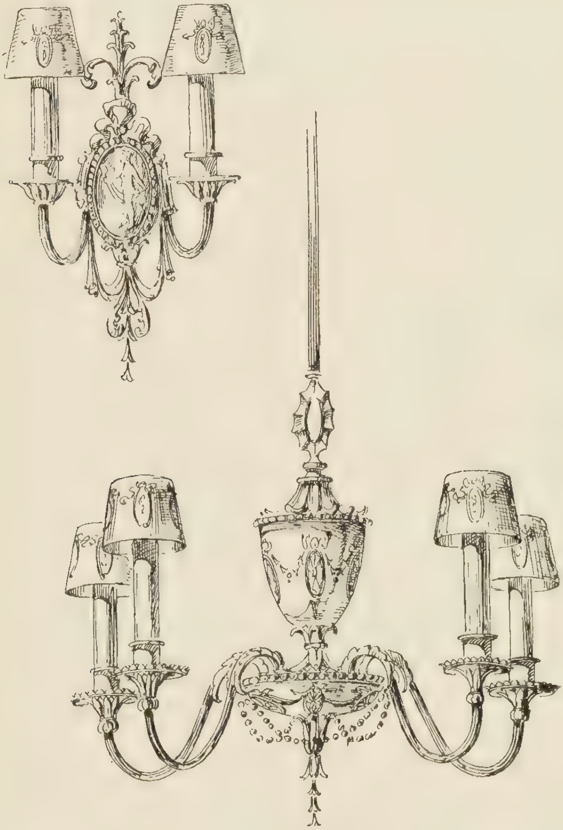

Fig. 74.—Modern Adam.

Chippendale is supposed to have designed the lantern or pendent lamp illustrated in Fig. 75. The French leaf of the Rococo style is seen. This is the flowing acanthus leaf with rounded terminals. The work of Chippendale is somewhat fanciful, perhaps the result of his association with Chinese motifs. The metal work of the fixture illustrated in Fig. 75 is appropriately old gold, and the panels may consist of glass, silk, or other textiles. The art of other styles and craftsmen in the Georgian period is illustrated in Chap. XII and the spirit of this period is seen in Figs. 56 to 61. In modern fixtures which have no prototypes in past periods we must be satisfied largely with decorative details which suggest the period.

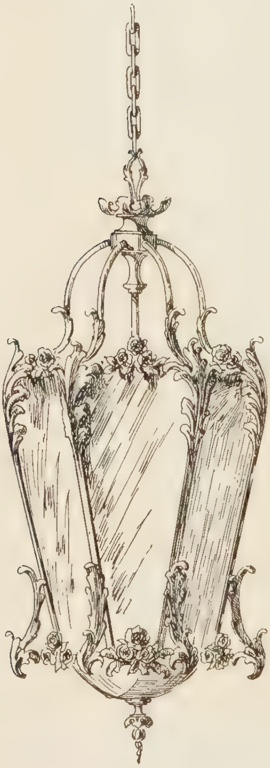

Fig. 75.—Chippendale lantern.

The Italian Renaissance which followed the Romanesque and Gothic was a period of elaborate classic styles. The artists of that period added much delicate and exquisite ornament to the old Roman and Greek heritages by exercising a refined freedom. Arabesque scrolls, acanthus leaves, ribbons, flowers, fruit, human figures, animal forms, and conventionalized designs were used profusely. The Renaissance was born in Italy and really belongs to that country. It spread to other countries where its influence was more or less powerful. Many adaptations of fixtures and motifs of the Italian Renaissance are used in modern lighting. Examples of these are illustrated in Figs. 42, 76, 95, 100, and 101. Iron, gilt, and polychrome are characteristic of the fixtures of that climax of art development.

The French Renaissance was born in the Italian Renaissance and its art products more closely resembled those of contemporaneous Italian style than did the art of any other country. We know best the styles of Louis XIV, XV, XVI, and Empire, which are illustrated in Figs. 43 to 49. A modern adaptation of Louis XIV style is illustrated in Fig. 152. Such motifs as the shell and cupid head and the defined leaf are characteristic. Royal patronage of art was a powerful stimulus and the tendency was toward elaborate, gorgeous, and magnificent interior decoration and furnishing.

The refinement of the Louis XIV style degenerated during the reign of Louis XV, which was a debauch of extravagance.

Unrestrained ornamentation and excessive freedom in form are characteristics of this period, as illustrated in Figs. 45 and 46. A modern adaptation of a fixture of Louis XV or Rococo period is illustrated in Fig. 77.

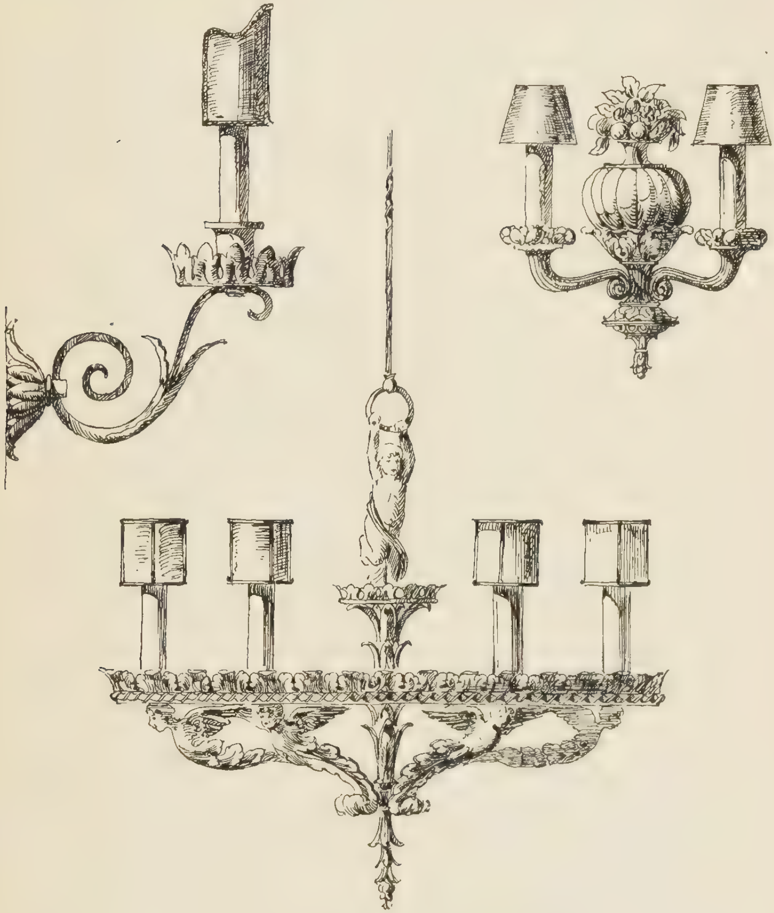

Fig. 76.—Modern Italian Renaissance.

During the reign of Louis XVI refined elegance took the place of the previous lack of restraint and many of the fixtures of this period were of classic beauty and dignity. The classic feeling was again becoming established, as illustrated in Fig. 47. A modern adaptation of a Louis XVI fixture is illustrated in Fig. 78.

After the French Revolution, Napoleon established the Empire, and during his reign the Empire style (Fig. 48) developed. The French people were not in the mood to countenance anything which was suggestive of the rule of the preceding monarchs. Therefore, it was natural that the tendency toward the classic revival in art which set in during the reign of Louis XVI became stronger in the Empire style. This tendency was encouraged by the personality of Napoleon. This conqueror saw himself a reincarnation of a mighty Roman monarch, and the art of the period is replete with details suggesting victory and power. This borrowing of classic details and the absence of extravagant royal patronage and support which art had enjoyed during the previous century could not result in as creative an art as was characteristic of the French Renaissance. The Empire style is interesting, popular, and distinctive, but it seems to possess a coldness of borrowed classic art unwarmed by Latin feeling. The Emperor's influence was also one of coldness, dignity, and superiority which did not encourage warmth of feeling and creative enthusiasm. Perhaps it was too soon after the horrors of the Revolution for the artists who had witnessed the wholesale destruction of works of art to put their hearts into creativeness. Nevertheless, the Empire style has much to commend it. A modern adaptation is illustrated in Fig. 79.

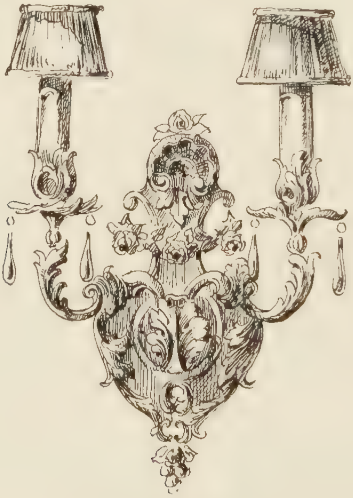

Fig. 77.—Modern Louis XV or Rococo.

The American colonists furnished their homes to some extent with things brought from Europe. In New England and Virginia the English styles prevailed and the Georgian influence was prominent. The Dutch settled New York and with them came their art traditions. In Louisiana the French transplanted the Louis and Empire styles. In Florida and the Southwest the Spanish influence prevailed. Our Colonial style (Figs. 62 and 63) is naturally a product of these various influences superposed upon a new land and a new civilization. The chief influence was Georgian, although the late French Renaissance and Empire styles made themselves felt. During the Colonial period the modern oil lamp was used as well as candles, and glass chimneys were introduced. Modern adaptations of Colonial fixtures are based on oil lamps as well as candle fixtures. Figure 80 illustrates a modern Colonial fixture with the oil lamp as a motif.

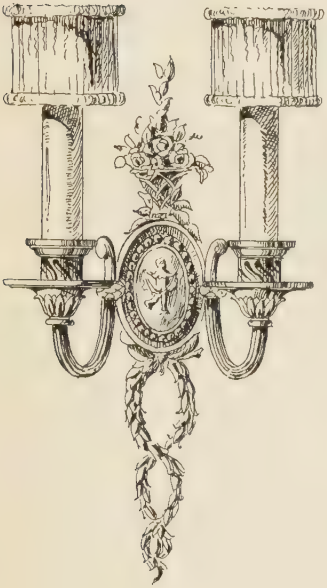

Fig. 78.—Modern Louis XVI.

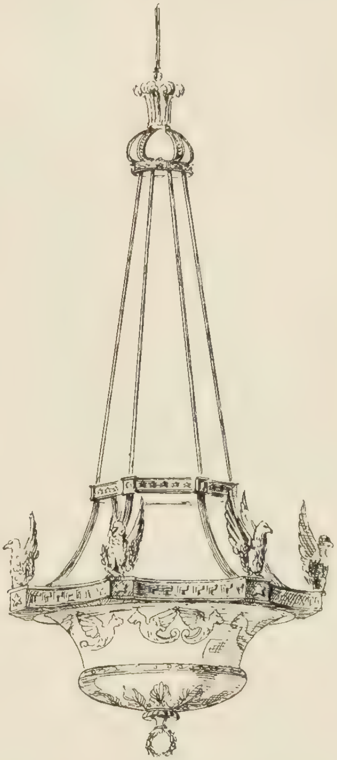

Fig. 79.—Modern Empire.

The glass shades were often of slender vase form and the decoration shown in Fig. 80 is characteristic. Brass is an appropriate metal, although iron and silver were also used. Crystal glass—clear, cut, or etched—is commonly associated with Colonial fixtures. Unfortunately, these glasses do not diffuse the light sufficiently to protect the eyes from discomfort. Here we should compromise in favor of proper lighting. Decorative diffusing glass, parchment, and textiles should take the place of the original crystal glass. Other modern adaptations of Colonial lighting equipment are illustrated in Figs. 80 and 115. A modern Colonial lantern equipped with a reflector for effective lighting is illustrated in Fig. 120. (Also see Frontispiece.)

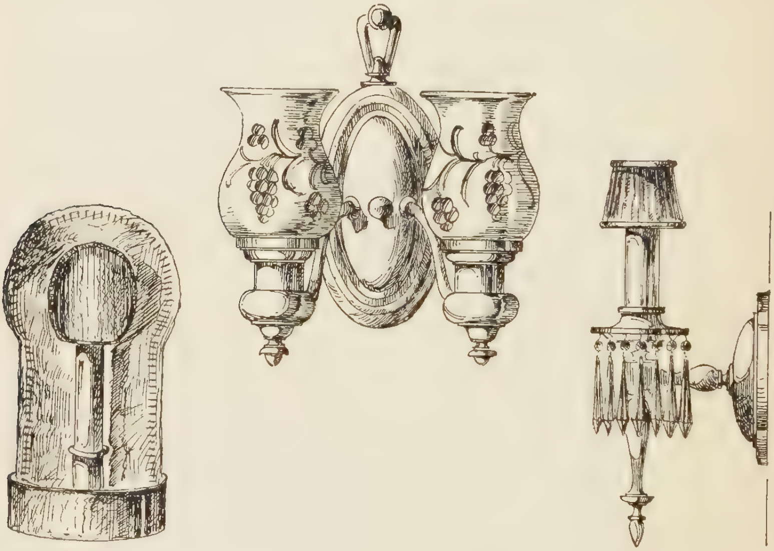

Fig. 80.—Modern Colonial.

The Near East or Oriental influence was introduced into Spain by the Moors. It has left its mark on much Spanish art. There is charm about the Spanish interior which appeals to those who enjoy stepping out of the beaten path. Furthermore, in this country we are fascinated by the romance surrounding the Spanish architecture of the South and Southwest and particularly by the remains of the Missions established by the padres. Figure 81 illustrates a lantern, a bracket, and a chandelier of modern design but of Spanish spirit. Old brass, hammered iron, copper, bronze, lead, and gold are suitable metals for their construction.

Modern adaptations of Chinese and Japanese motifs to lighting often take the form of lanterns. The pagoda is a conspicuous form and the details of ornament are the well-known ones of the Far East (see Figs. 24, 25, 82, and 153). Many unique applications of these motifs may be made in lighting. The bronze temple lamps afford excellent motifs for strictly Far East interiors of elaborate fidelity in style. These may be used purely for ornamental lighting or for utilitarian lighting. By introducing modifications or concealing equipment for controlling light, very

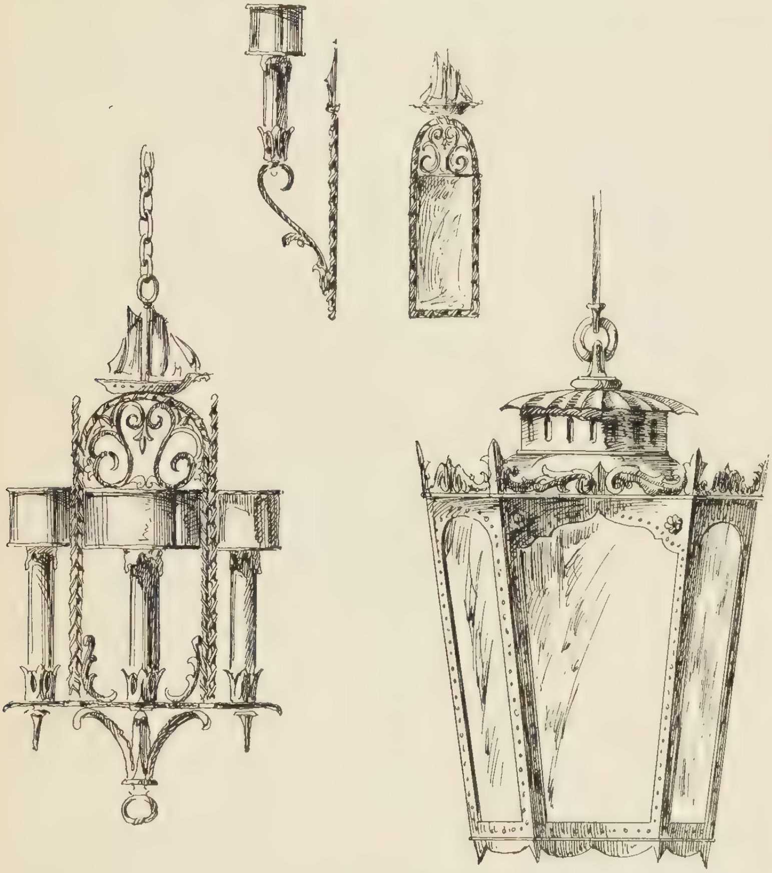

Fig. 81.—Modern Spanish.

effective lighting may be obtained. However, the usual adaptations are in the form of lanterns constructed of wood and light metal and enclosed by painted or embroidered fabrics. Simple placques or shields on the wall are used to conceal electric-filament lamps. Shades for modern portable lamps may be of a form suggestive of the Far East, as well as consisting of characteristic materials and ornamentation.

Gas lighting was introduced into cities about a century ago. This new phase of lighting required for the first time that lighting equipment be fixed in position, owing to the necessity of piping the gas to the burner. This had its influence on fixture design, because brackets and pendent fixtures were necessary. Just as with other flames, the gas flame was upright and shades also had to be upright. It was natural that the gas fixtures should be constructed chiefly of brass. Some exquisite ones were made, but most of them were unattractive products of mechanics rather than the work of artists Figure 83 is a good example of a gas-lighting fixture with a suggestion of the spirit of Italian

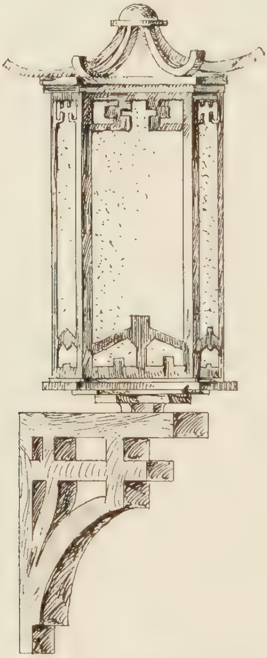

Fig. 82.—Modern Japanese.

Renaissance. Dutch feeling was also common in such fixtures. When these flames were replaced by electric lamps, the shades were sometimes installed upright as a matter of habit or expediency. This resulted in so-called semi-indirect lighting, which was not popular when light was produced at a cost several times that of the present time. As a consequence, the sockets and the shades were generally pointed downward at an angle, and the result was glaring light sources from which there was little opportunity to escape. This was a period of lighting never exceeded in atrociousness.

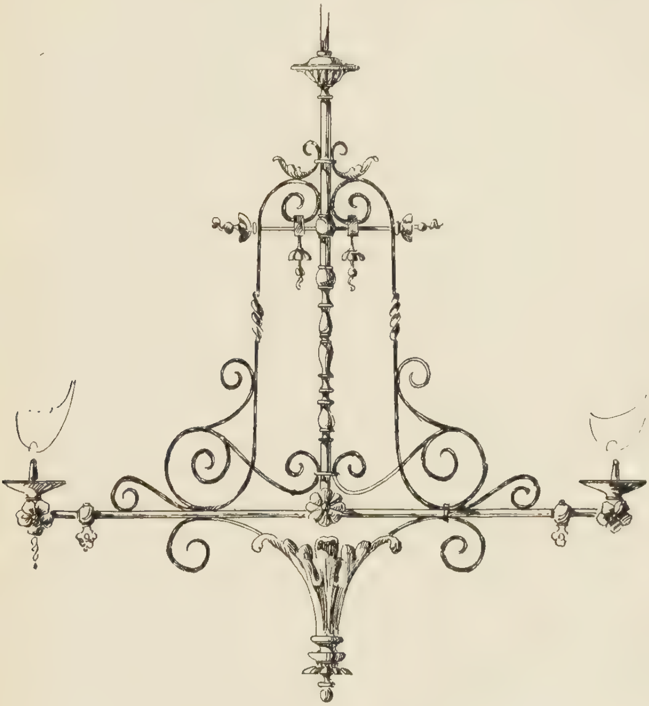

Fig. 83.—Gas fixture.

ART NOUVEAU

Since the decline of the Renaissance, no powerful influence has appeared which has permanently and definitely altered the trend of art. Various movements arose, but the spirit of the Renaissance has prevailed in the countries where it became deeply rooted. Nevertheless, a spirit of independence from traditions of the past has been asserting itself. The most recent rebellion from imitation of past styles developed during the latter part of the nineteenth century in France, Belgium, Austria, Germany, and England. It has been given various names, but, inasmuch as it originated in France, it is generally known as Art Nouveau. There does not appear to be a unified viewpoint among the various groups who have worked in this direction of so-called independence. Perhaps the most common and striking trend is toward Nature for inspiration. Others denounce this tendency and strive for other inspirations, however.

This movement could have been discussed at the end of Chap. XII, but to have done so might have been misleading. It has no right to an equal footing with other recognized styles, because it has not produced a distinctive style of decorative design. Its spirit is real, however, and it has wielded an influence which tends toward freedom in design. It shows that the preceding styles have not exhausted the supply of decorative forms.

Art Nouveau is reminiscent of the styles of Louis XV and XVI. From Nature and elsewhere came the inspirations which resulted in sinuous lines and many curves, as if there was a studied effort to avoid straight lines, right angles, and logical geometrical forms. The effects are sometimes beautiful, but they do not appeal to those who are in love with classic traditions. After all, style matters little and an artist who uses well the decorative forms which he borrows or creates produces a work of art.

It is difficult to choose illustrations as examples of Art Nouveau, because there are so many cross-currents. However, it is hoped that Fig. 84 illustrates fairly well one phase of the Art Nouveau which takes its inspiration from Nature and with a free spirit builds upon traditions of Louis XV and Louis XVI which cannot be completely driven from mind.

The English, striving also for independence, turned back to the style of Sheraton, but lavished decoraion of the new order upon it. They also returned to the cruder forms of Early English and developed their quaint style analogous to the so-called Mission style of this country. Our Mission style is crude, consisting of more or less meaningless forms, and is characterized by straight-line effects. Much oak wood is used and in fixtures the wood is stained a dark brown. The metal work is iron or old bronze. A Mission fixture is illustrated in Fig. 85. Its construction is of brown-stained wood and old bronze. The

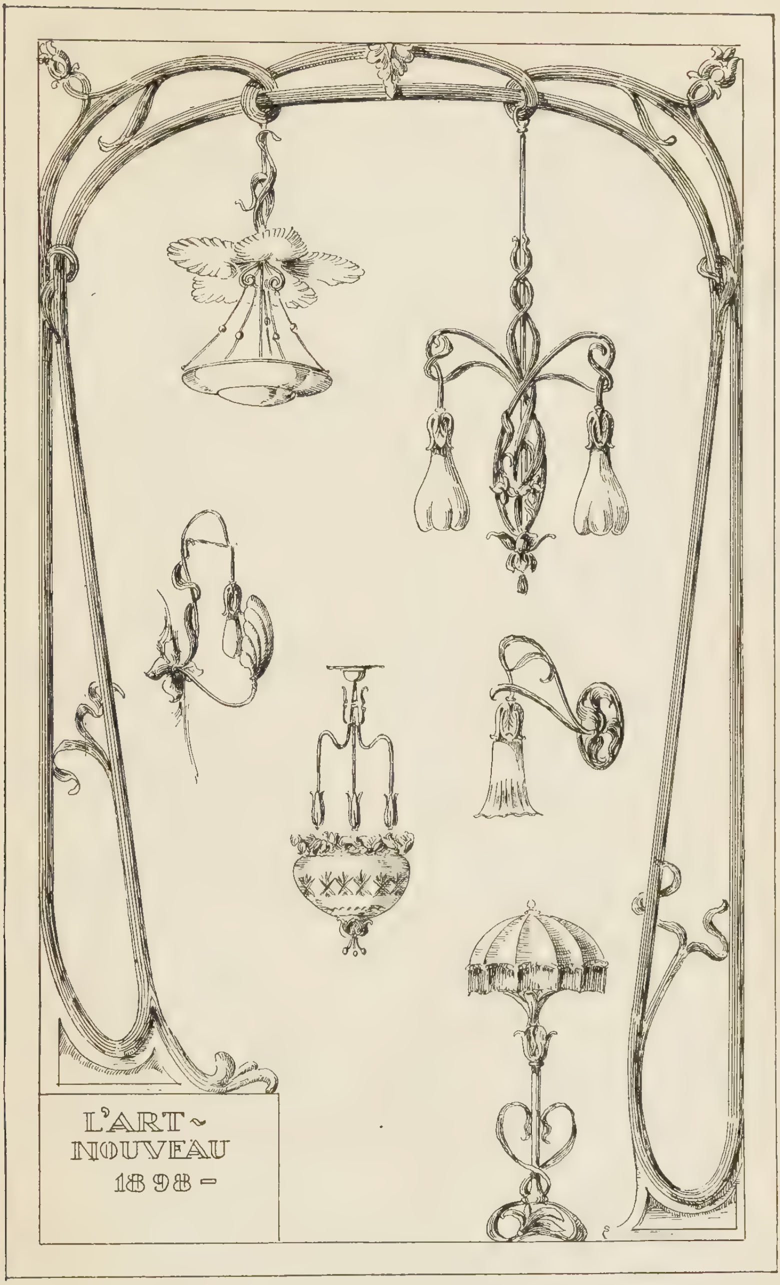

FIG. 84.

shades are characteristically so-called "art" glass. The Mission style arose from the furniture of the old Spanish missions established in California in the eighteenth century.

In this country, in which art traditions are not strongly intrenched, it is not difficult for a new art movement based upon independence from traditions to gain adherents. As a consequence, the sinuous lines of Art Nouveau have appeared in American art in a manner which suggest Japanese natural forms. Perhaps this phase of the new movement will achieve something worth while.

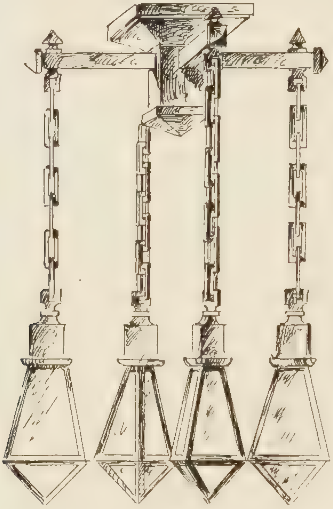

FIG. 85.—Mission.

CHAPTER XV

LIGHTING FIXTURES VERSUS LIGHTING EFFECTS

In the preceding chapter the first step in the adaptation of old fixtures to electric lighting is discussed and illustrated by means of a few modern reproductions of fixtures of certain period styles. In most cases electric lamps and sockets merely replace the older flames. For the sake of comfortable and artistic lighting, shades are supplied, but this is the only important change from the viewpoint of form. In these cases the primary interest is the fixture itself and therefore, reproduction of the form dominates the design. As previously stated, such fixtures are suitable for many lighting purposes, but they do not do justice to modern lighting possibilities. If we stop at this point, we scarcely tap the potentialities of modern lighting. Still, most of the fixtures available do not go beyond this, and it is obvious that considerations of the requirements and possibilities of modern lighting have not guided the designer or imitator.

If we are not to enjoy the possibilities of modern lighting because the necessary fixtures have no prototypes in past periods, why do we advance in other directions? It is quite certain that the designer of today does not disdain the automobile and ten thousand other products of modern civilization. The conclusion must be that the fixture designer of today is remiss in some respect. It may be a lack of creative ability, unfamiliarity with light control, failure to realize the potentiality of modern lighting, a misplaced loyalty to art forms of the past, a misconception of the function of the designer, or a failure to realize that all art of the past was a modification of previous work so that it fitted the new civilization.

The author stands first of all on the possibilities of modern lighting and on the greater demands which our present civilization make on artificial lighting. If some of the fixtures in this and in later chapters have no prototypes in bygone periods, then to this extent they are creations. If they are "meaningless" to so-called artists because they are creations and not imitations, we would ask these artists to contemplate any creation in art of the past. Their forms can be as suggestive as possible of a given period style and their decorative details can further supply the desired spirit. Civilized progress cannot be fettered by the worshipful imitator. It wants bathtubs, steam heat, and the best which artificial lighting can give.

In the examples of modern lighting equipment concealed in decorative fixtures, the attention of the author has been primarily directed to the lighting principles. The decorative exteriors may be treated in a variety of ways—as true to period style or as free from tradition as anyone may desire. This is particularly emphasized because the decorative details are matters of taste and skill, while the correctness or desirability of any lighting principle may be established by experimental investigation. Still, too often in the matter of lighting principles, opinions and conclusions are based upon inadequate experience and scanty analysis.

If we study modern lighting in its varous phases, we find that the proper lighting effect in a given case is comprised of two components of light, namely, direct and indirect. As stated in Chap. VII, there is also another factor pertaining to fixtures which we have termed the decorative element. This consists of the luminous parts of the fixture—the parts which vitalize it and give to it the interest and charm of variety. This factor is concerned entirely with the appearance of the fixture. For example, an indirect-lighting fixture which has no luminous portions to give it life is not usually totally satisfactory to the eye. A pleasing appearance is achieved by multiple lights, such as shaded candles or the luminous portions between the opaque ones. This is very important from the viewpoint of artistic design and, in order to achieve the proper result, the designer must visualize the fixture as it will appear when it is in operation.

The direct and indirect components are involved in lighting effect upon the objects and the interior itself. The direct component of light is that which is directed generally downward and is expressible in per cent of the total light emitted by the fixture. The indirect component is that which is emitted generally upward; that is, above an imaginary horizontal plane. If 30 per cent of the light is emitted generally downward, an idea of the lighting effect which the fixture would produce would be gained from the designation 30–70. The first number indicates the direct component and the second the indirect component.

This relation of direct and indirect components is not all that need be considered in determining the lighting effect which is produced by a given fixture in a room. The brightnesses of surfaces depend upon their reflection factors as well as upon the intensity of illumination. For example, a dark-colored rug or ceiling will not appear as bright as a light-colored one under the same intensity of illumination and to produce the same brightness distribution in different interiors the ratio of direct to indirect must be altered accordingly. However, experiments and observations indicate that the decorative scheme of a room is not as influential as the foregoing factors would suggest. Furthermore, other considerations are important. It would be tedious to go into a detailed discussion of specifications of these two components for various purposes and kinds of interiors because of the many factors which must be taken into account; however, a few generalizations arrived at by experiment and analyses should be helpful. In the pairs of numbers given, the first is always the direct component.[1]

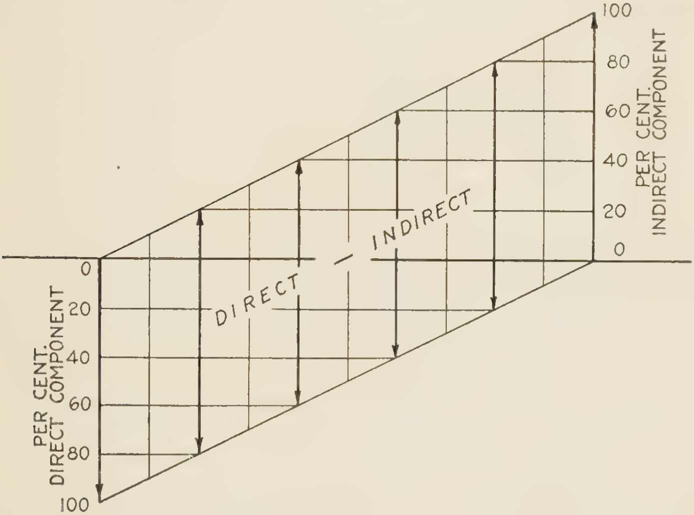

FIG. 86.—Representing various percentages of direct and indirect light. (*From The Lighting Art by M. Luckiesh.*)

Figure 86 presents a graphic illustration of all possible relationships of the direct and indirect components of light from fixtures.

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[1] LUCKIESH, M., "The Lighting Art;" McGraw-Hill Book Co., 1917.

This should aid in visualizing the various lighting effects. The same diagram also applies to a lighting effect as a whole, even though it is obtained from various fixtures, concealed lighting, etc., as discussed later.

A totally direct-lighting effect has no place in most interiors.

The lighting effect from portable lamps for reading and similar purposes is most satisfactory when it is predominantly direct light. If the lighting is totally direct, the effect is too contrasting and the eyes tire rapidly when viewing a bright page against a rather dark background. Proper lighting will be found usually when the direct-indirect relations are between 80–20 and 50–50.

Incidentally, on an average clear day about 80 per cent of the light reaching the earth's surface is direct sunlight and about 20 per cent comes from the entire sky.

Experiments in the dining room of the home show that the direct component which illuminates the table should dominate over the indirect component from the fixture. The preferred ratio for dining rooms of various decorative schemes is usually found to be between 80–20 and 60–40. Obviously, the best effect cannot be obtained with chandeliers on which the lamps are not shaded. The usual suspended so-called candelabra emits more light upward than downward.

The hotel dining room presents a different condition. Here, there is not the strong motive or desire for coziness. Expanse, magnitude, and the crowd are a part of the atmosphere. It is usually impossible to hem in an individual table by subdued lighting and such an effect is not expected. Besides it is a show place. Diners want to see others and (dare we say?) want to be seen. But even here the final touch is added by the shaded electric candles or small portables on the tables which make the tables the high lights among the other surfaces. This is a touch of coziness which is carried over from the residential dining room. The general lighting of such a large public dining room is best achieved when the indirect component dominates and the best relation of direct-indirect is usually found between 40–60 and 20–80. The direct component in this case is best supplied chiefly by what we have termed the decorative element. This is readily produced by the shaded lamps of a chandelier and by shaded electric lamps on the indirect-lighting fixture. High lights from the crystals of glass and polished metal or gilt surfaces also aid in producing the desired effect. These high lights are necessary if jewels are to sparkle and silk gowns are to show to advantage. In the dining room where the ceiling is of a low reflection factor the lighting effect, or for that matter the appearance of the interior itself, cannot be the most pleasing.

In the formal ballroom, sparkle is also desired. Here we may even justify unshaded frosted electric lamps and glittering crystalline chandeliers. Splendor is a pleasing part of the setting. We do not linger here. The dancers are in motion; the fixtures are hung high; and much time is spent between dances. Even the usual glaring wall brackets are not so offensive in a ballroom as elsewhere, but, owing to their locations, the lamps should be shielded. In the ballroom a variety of lighting effects is suitable, as discussed in a later chapter. However, if these are not provided, the best lighting will usually result with direct-indirect components somewhere between 50–50 and 20–80. The percentage of indirect light can be large if there is sparkle in the general effect.

Auditoriums are good examples of interiors where the indirect component should dominate. This provides a lighting effect fairly free from glare. Totally indirect is sometimes satisfactory, but usually some luminosity is desired in the lighting fixtures. Even sparkle may not be out of place and this can be obtained in satisfactory degree where the indirect component is very dominant. In some auditoriums visible lighting fixtures are impractical or not worth their cost and maintenance. The relation, direct-indirect, is usually satisfactory if it is between 30–70 and 10–90. As already stated, it sometimes is satisfactory if it is 0–100; that is, totally indirect.

Churches may be considered on the same basis as auditoriums, but the architecture and the decorative scheme often make it impracticable to have an indirect component of high value. Furthermore, churches, such as the Gothic ones, have traditions which must be respected. The dark ceilings are places where shadows should linger. This point is discussed later.

Stores and distinctive shops have various lighting requirements, depending upon a number of factors. However, they are places where merchandise is sold and, therefore, this must be seen and displayed. Usually, the direct component should dominate or at least it should be prominent.

The refreshment shop and the public dance hall are examples of interiors where a variety of lighting effects adds novelty. The whole gamut of lighting effects is available for such places.

These are a few typical examples which should suffice. The arguments presented may be readily modified to meet other interiors and conditions. The purpose at this point is to suggest to the reader the manner in which lighting for a specific interior should be considered.

In the preceding paragraphs we have discussed lighting effects as if they were to be obtained by a single fixture or by a number of similar ones. If we desire a certain lighting effect, it may be obtained by a combination of lighting fixtures or methods. Now we need only to apply the same analyses to the lighting as a whole that we did to the fixture in the foregoing paragraphs. For example, if we desire a lighting effect in a hotel dining room which is made up of a 30 per cent direct component and a 70 per cent indirect component, we may obtain some of the indirect lighting from lighting equipment concealed in various places. Light sources behind a cornice, in corbels, or in huge urns will suffice. Direct lighting may be obtained by suitable fixtures. Even a great expanse of ceiling skylight illuminated from above may supply much of the indirect component, for the effect is no different from an opaque ceiling illuminated from below. In a dining room in a residence we may utilize a glass ceiling, wall boxes, a cove, or other devices for obtaining the indirect component. The same scheme applies to other interiors.

When we have begun to think of lighting effects instead merely of fixtures, the limitations of lighting fixtures become evident. There is no limit to the possibilities of lighting when we realize that we have at our command all the devices which our ingenuity can muster. Artificially illuminated skylights and windows, wall boxes, wall plaques, indirect-lighting portables, urns and vases, false ceilings, lattice and grill work, luminous ornaments, wall niches, architectural details, and the great variety of lighting devices, such as reflectors, refractors, lenses, mirrors, and colored accessories, are among the tools available for lighting. With this formidable array of allies and with a broadened view of lighting which they aid us in acquiring, we come to realize the inadequacy of fixtures borrowed from bygone ages. These are little more than gems of art, inspiring to us and useful to some extent, but still inadequate for utilizing the potentialities of modern artificial light. Are we to be satisfied with them alone as the primitive being was with his baubles?

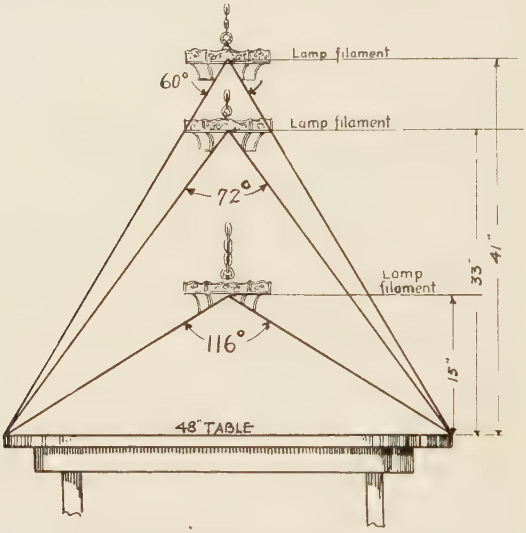
CHAPTER XVI

PROVIDING DIRECT LIGHTING PLUS

The possibilities of modern lighting can be demonstrated best by considering specific lighting problems. In the preceding chapter, a brief discussion pertaining to direct and indirect components of light is presented. Extensive experiments have shown that the most preferred effect in the dining room in the home is achieved when the top of the table is the brightest surface in the room (exclusive of the lighting fixture). This result may be obtained in several ways, but only by providing a higher intensity of illumination on the tablecloth than on a surface of equal reflection factor. If the effect is satisfactory when a white table covering is used, it is not usually so satisfactory when the table is relatively bare of light-colored covering.

The most practicable method of obtaining light on the table predominantly is by means of a fixture suspended from the ceiling directly above the table. Let us consider some of the possibilities by means of a few examples. In the designs illustrated herewith the dominating viewpoint is that of lighting effect. The decorative details are considered secondary for the present. They may be readily altered to suit anyone's taste. Furthermore, it should be realized that period style is not very important in most residences. Certainly, it may be suggested as much in these fixtures as it is in most interiors. Besides, we are now entering a phase in modern lighting where art must be adapted to meet new requirements and possibilities.

From the viewpoint of proper lighting effect, the old pendent dome is admirable. Even the hideousness of some of these old fixtures cannot rob this type of fixture of credit for embodying a correct lighting principle. The pendent dome illuminates the table in a straightforward manner and provides a dominant direct light of about the proper ratio to the indirect component if the dome permits a sufficient amount of light to escape upward. Some modern dome fixtures are improvements artistically, but from a scientific viewpoint they can be improved upon. The large aperture of the dome makes it necessary to hang the fixture rather low (see Fig. 87). This is often objectionable from the viewpoint of seeing across the table. The low-hung dome also obtrudes itself unduly upon our consciousness when seated at the table. It is obvious that a dome with a smaller aperture can be hung higher and better control over the direct component is obtained, so that even in this higher position the direct light does not enter the eyes of the diners. With this idea in mind, the author constructed several such fixtures and experience with them for ten years has proved that they are superior to the old low-hung dome of large aperture. Besides, several advantages obtain which are discussed later.



HANGING HEIGTH IS DETERMINED BY THE DIAMETER
OF OPENING THRU WHICH LIGHT IS EMITTED, AND
DISTANCE OF LAMP FILAMENT ABOVE OPENING.

FIG. 87.—Illustrating fundamental principles of a direct-lighting dome for the dining table.

Much of the discussion which is herewith applied to the lighting of the dining room, and particularly of the table, also may be applied to other places where a prominent component of direct light is desired. Examples of such places are small living rooms, where a ceiling fixture must be depended upon for illuminating the library table. Such lighting would be suitable for distinctive shops where the fixtures should supply effective lighting and should be decorative. However, for the sake of simplicity in treatment, the dining room of the home is chiefly used in the following paragraphs as a basis of discussion. In many of the designs which are suggested, more than one electric circuit is included. In practice, the ideal arrangement would be to have an independent wall switch for each circuit. However, such fixtures are likely to be installed where only one circuit is available and, therefore, switches should be included in the fixture. This is easily done in most cases.

The principle just discussed is well illustrated in Fig. 87. Assuming that the aperture is circular, a cone of direct light

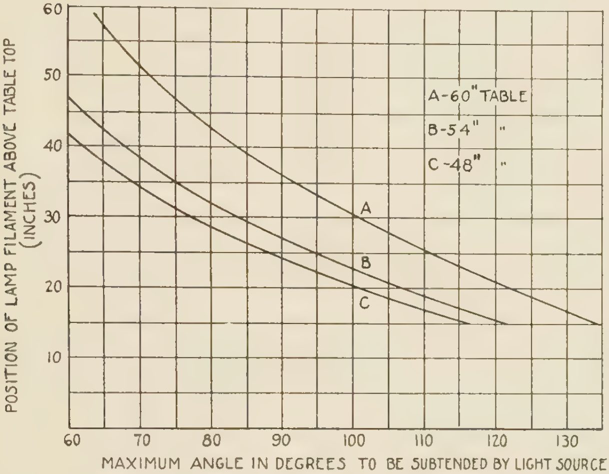


FIG. 88.—Illustrating the relation between the height of the light source above the table top and the solid angle of light necessary to illuminate the table.

emerges, as shown by the straight lines drawn from the lamp filament through the edge of the aperture. The angle of the apex of this cone of direct light is determined by the diameter of the aperture and by the height of the filament above the plane of the aperture. The height of the fixture above the table determines the area illuminated by the direct component. As the aperture is decreased in size or as the height of the filament above the aperture is increased, the angle of the apex of the cone of direct light becomes smaller and, therefore, the proper hanging height becomes greater. A study of Fig. 87 makes these relationships clear. The aperture of the dome may be rectangular, so that a pyramid of direct light is obtained. This is suitable for rectangular tables. However, the edge of the shadow can be so modulated that even an extended table or one of any shape is satisfactorily illuminated. The eyes of the diners are well outside the cone or pyramid of light.

In Fig. 88 three curves are given for three widths of table, respectively, 60, 54, and 48 inches. These show the relations between the height of the lamp filament above the table top and the angle which must be subtended by the aperture. This determines the size of the aperture and the height of the filament above it for any height of the filament as great as 60 inches above the table. From this diagram a fixture providing a direct component of proper angle may be designed. The diagram is presented to illustrate the principles involved. The designer should work out the problem graphically to scale. In fact, this suggestion emphasizes the advantage of proceeding in this manner in the design of fixtures, although this procedure is seldom adopted in connection with so-called decorative fixtures. On a scale drawing, straight lines drawn from the light source to various points, such as the aperture of a shade, reveal much information in regard to the lighting effect which will be obtained.

A simple application of the foregoing principles is illustrated in Fig. 89. Superficially, this appears like an inverted dome with its aperture at the top rather than at the bottom. However, the important aperture for the direct component of light is at the bottom and is restricted to a diameter of a few inches. Four inches is ample. A diffusing glass reflector is fitted into this aperture as shown and the height of the filament is carefully determined for a certain hanging height in accordance with the principles illustrated in Figs. 87 and 88. The light which diffuses through the glass shade illuminates the exterior textile shade and much of this light escapes upward, thereby supplying the desired indirect component. By using the inner glass reflector, a sufficiently dominant direct component is obtained. If this shade is absent, a less powerful direct component will escape through the small aperture and the result will not be the most desirable relation between direct and indirect lighting for the dining room. However, fairly satisfactory simple fixtures can be made without this inner reflector (see Fig. 92). The fixture illustrated in Fig. 89 is Japanese in spirit of form and decoration.

A simple fixture embodying this new idea is illustrated in Fig. 90. The upper part of this modified dome consists of a quite shallow, dense opal-glass shade. Its edge may possess a channel, so that the draw-string of the textile may be held in place. The small aperture at the bottom may be made by fastening a metal ring in the pleated textile, which will hang, as indicated, by its

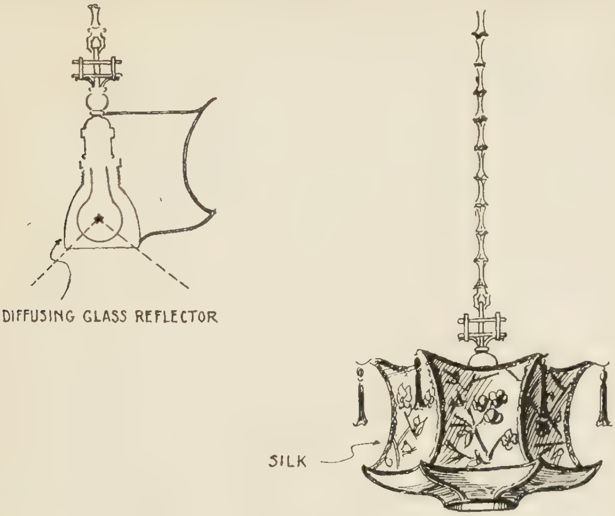


Fig. 89.—Suggestion for a direct-lighting fixture for the dining room (Japanese spirit).

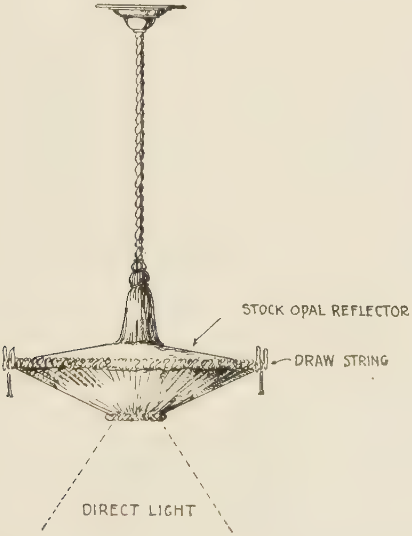


Fig. 90.—A fixture providing dominant direct light.

own weight. The opal-glass shade reduces the indirect component and increases the direct component, so that the latter predominates sufficiently. The glass portion of the fixture may be of the shape indicated in the illustration by the glass and the textile. The upper portion of this glass frame may be enameled, but the lower portion, which is covered with the silk, may be left clear, and it may contain a small aperture a few inches in diameter. There are other obvious modifications of this idea.

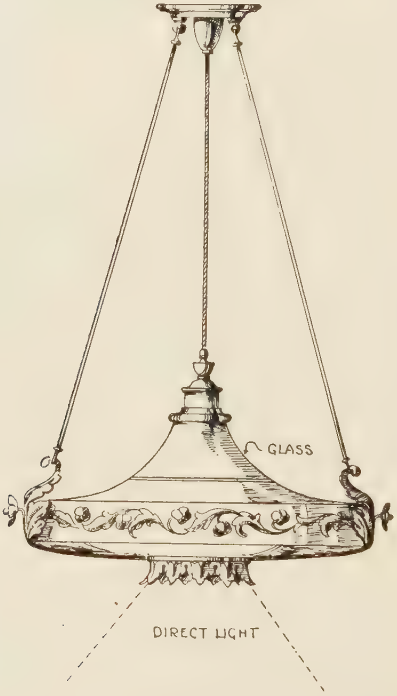


Fig. 91.—A glass fixture with small opening in the bottom for emitting direct light.

The combination of glass (enameled, clear, and prismatic) for controlling light with parchment and textiles for the sake of appearance has many applications in lighting. In most direct-lighting fixtures, frosted lamps or lamps with diffusing glass bulbs may be used to advantage.

The modern dome of decorated diffusing glass may be improved by reducing the size of the aperture. This may be accomplished by blowing the piece of glass so that it totally encloses the light source except for a small aperture in the bottom (see Fig. 91).

The glass may be densely diffusing and decorated in some manner as shown. The decorative details in this illustration are Italian Renaissance. The aperture through which direct light is emitted is surrounded with a metal fringe, which is not only decorative, but also aids in screening the interior of the fixture and the lamp filament from view. Instead of decorating this glass, a deep cylindrical textile shade of the maximum diameter of the glass may be supported from the outer edge of the glassware. This is one of many examples of the possibilities of combining utilitarian glass with decorative parchment, textiles, and other media which are easily handled.

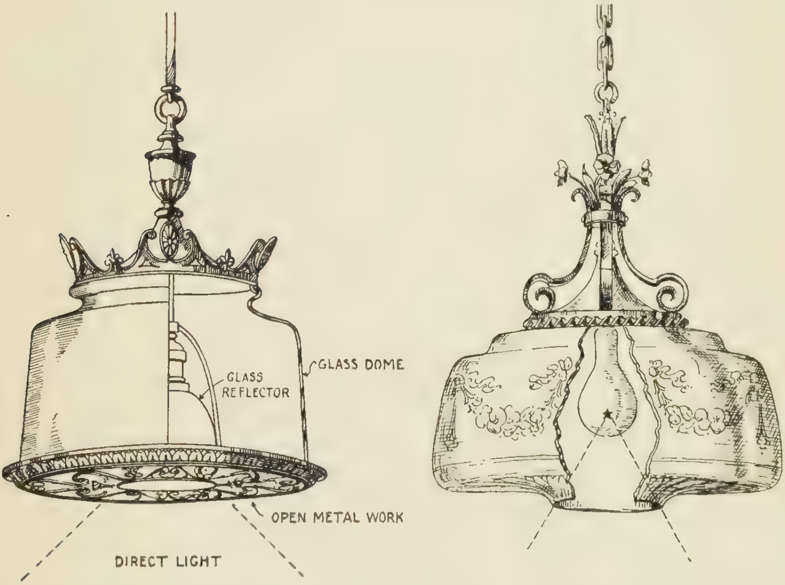


Fig. 92.—On the left is illustrated a means for confining the lower aperture of a glass dome to a small area, above which a diffusing glass reflector is located. On the right is a simple dome consisting of one piece of glass with a small aperture in the bottom and no reflector inside.

The modern glass dome of large aperture may be improved by supporting from the lower portion of the glass a metal grill which has an aperture in the center a few inches in diameter, as illustrated in Fig. 92. The portion of this grill outside the central aperture may be covered with textile fabric, parchment, or glass. The light source may be supported in the proper position inside the dome, or it may be placed in a glass shade, as in Fig. 89 and in other illustrations. It may even be metal, but in this case auxiliary light sources would be necessary to illuminate the dome and to supply the moderate indirect component desired. The other illustration in Fig. 92 is a simple dome of diffusing glass improved by contracting the lower aperture as shown.

In such fixtures as are illustrated herewith it is possible to use a so-called daylight lamp without having the general lighting cold in effect. The daylight lamp gives a fairly white light and under its illumination white china and cloth appear pure white. The flowers and decorations on the china appear in true colors. All in all, the effect of this white direct component is quite pleasing, provided the indirect light and that reaching the faces of the diners is of a warmer color. This may be achieved by tinting the glass, textile, or whatever the medium by which the light is diffusely transmitted, a warm color. Thus, we have the advantage of white light on the table and a warm light diffused over the diners and the entire room (see Fig. 96).

No other medium is so attractive as light, from the viewpoint of the ease with which different effects may be produced. If the lighting facilities are available, a pressure of a switch alters the mood or the expression of the interior. Variety is the spice of lighting as well as of life, and modern lighting possesses great possibilities in this respect. Our moods and the occasions in our home vary. When they do not, we have monotony. Why not provide variety in lighting to some extent in fixtures? In the living room which is properly lighted with portables of various designs, variety may be obtained by lighting different combinations of portables. This is one of the reasons for the popularity of the portable lamp. In the dining room we have the restful coziness of the family dinner or the festive affair with guests. If we visualize all the different moods and occasions, we must conclude that here is a place for introducing the variety of lighting.

The next step, after the primary lighting by means of a dominant direct component is provided, may be to supply an indirect component of secondary lighting. Experiments show that a range of relationships between the direct and the indirect components is interesting. It makes it possible to suit our mood and also the occasion. Figure 93 illustrates a design in which an indirect component is supplied by an extra circuit. The inner shade for the direct component may be opaque, but a dense diffusing glass leaves the extra circuit free. If this inner shade were opaque, no light would escape upward and the additional circuit would have to be used to supply the indirect component. It is best to leave it free for additional effects. For example, tinted light obtained by colored lamps or by covering the lamps with colored media may be introduced by means of the additional circuit as secondary lighting. A cold blue light may be showered over the upper part of the room, to be reflected again over the entire room. The warm light of flame-tinted lamps and other tints and colors may be used, depending upon the psychological effect desired. This secondary lighting produces very interesting effects, but it should not be of sufficient intensity to overwhelm the direct lighting. Those who have not experimented in this manner have little realization of the possibilities in this direction. It is hoped that critics of such applications of the potentialities of modern artificial light will base their analyses on sufficiently

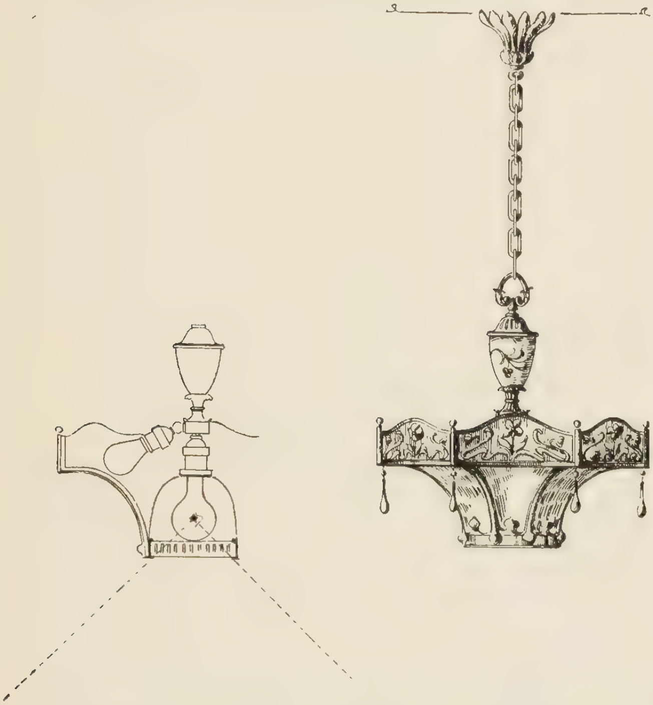


FIG. 93.—A suggestion for a modern dome fixture, including light sources for supplying an indirect component.

extensive investigations. The mobility of modern electric light is well demonstrated in such a case as the foregoing, for these effects come into being and disappear by the pressure of a switch. Furthermore, this is one of our few opportunities to use color daringly in our homes, because we need to live with it only when we desire to.

Another design similar in lighting principle to Fig. 93 is illustrated in Fig. 94. The aperture in the bottom of the unit may be only a few inches in diameter. One as small as 3 inches proved to be quite satisfactory, although 4 inches is better. As previously stated, this aperture may be rectangular as well as circular. An inner dense diffusing glass shade is used for the direct component and some light is diffused upward, thereby contributing a slight indirect component. This design is similar in principle to Fig. 89, except that an additional circuit is installed as in Fig. 94, and for the same reasons. This makes a very simple, effective, and attractive design, which has been used by the author for ten years. Obviously, the piece may be made entirely of glass which, when properly decorated and tinted would be very attractive. For the sake of variety, we have suggested in Fig. 94 that the lower portion may consist of a dense glass bowl supported by the cylindrical band of metal openwork,

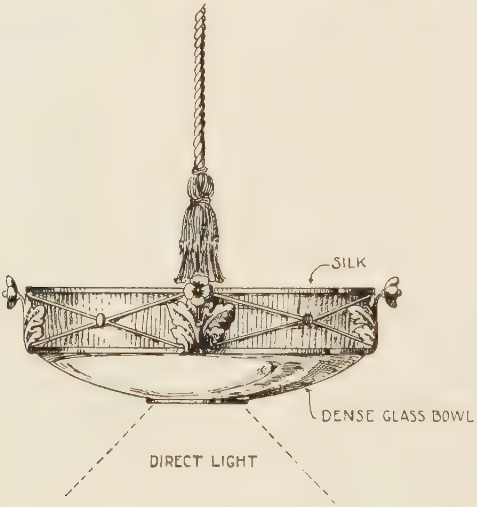


Fig. 94.—A dining room fixture supplying dominant direct light and a secondary indirect component.

behind which pleated silk is placed. The decorative details are the acanthus leaf and colored flowers of Italian Renaissance spirit. A silk cord and tassel complete the suggestion. As already stated, the exterior lends itself to the use of various media and decorative details.

A similar suggestion is illustrated in Fig. 95, the decorative details being of the spirit of Italian Renaissance. The framework is of metal, ornamented with colored metal flowers. A shallow flat glass bowl is combined with a tall glass cylinder, as shown in the skeleton drawing. The direct component is emitted by the aperture and the diffusing glass cylinder contributes some indirect light. The indirect component consists largely of the light contributed by the lamps in the flat, shallow bowl, but these also provide some diffused light downward through the bottom of this flat bowl. Art glass of interesting texture and warm tint is suitable for this fixture.

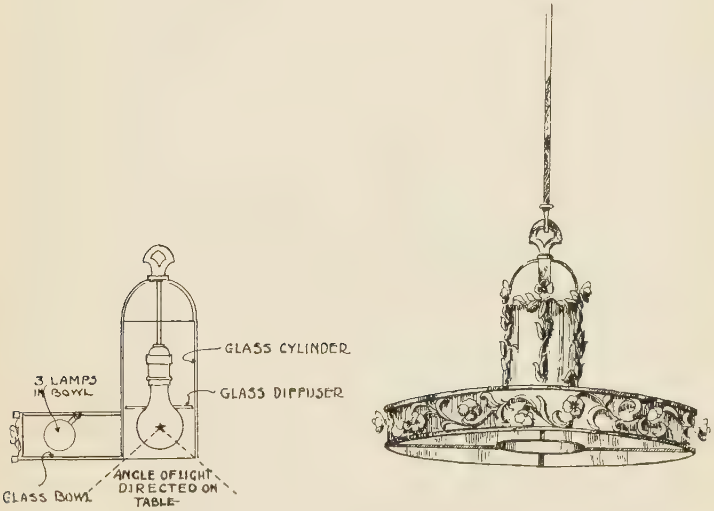


Fig. 95.—A fixture supplying direct and indirect light from two different circuits.

A dense glass bowl decorated in classic Roman spirit is illustrated in Fig. 96. The inner shade which supplies the direct component is a silvered reflector. A cylindrical skirt of warm yellow silk closes the gap between this reflector and the lower aperture in the exterior bowl. When only the central light source is in operation, the light which is transmitted by the silk band illuminates the exterior bowl faintly. Thus the bowl is rendered luminous and of a warm tint, while white light (from a daylight lamp if desired) is directed upon the dining table. (A dense diffusing glass shade may be substituted for the silvered reflector and silk skirt.)[1] Another circuit supplies lamps contained in silvered reflectors as shown. This supplies the indirect component. A third circuit may consist of lamps (without shades) located between the silvered reflectors which supply indirect lighting. The third circuit is not shown. The author designed this fixture about ten years ago and has used it in an experimental room for about eight years. Reactions from thousands of persons and certain extensive tests prove conclusively that such control of light and the variety of effects which are produced are interesting and attractive and that simple

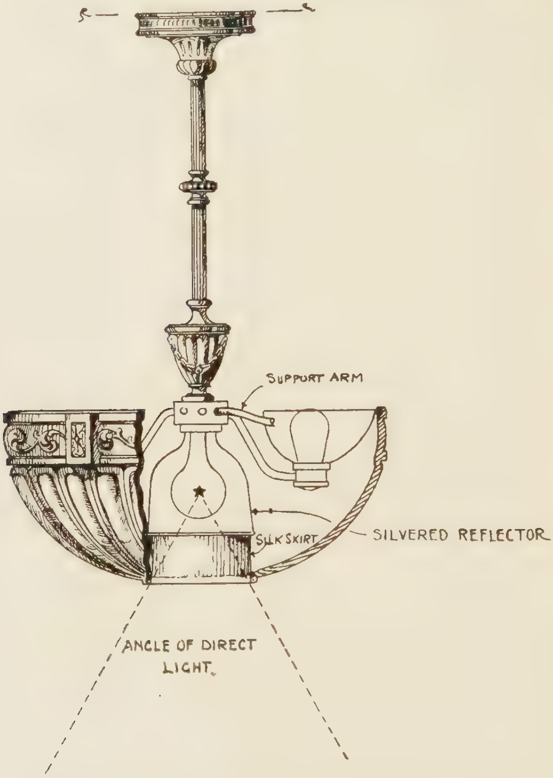


FIG. 96.—A fixture supplying direct light for the table and also an indirect component.

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[1] LUCKIESH, M., "The Lighting Art," McGraw-Hill Book Co., 1917.

fixtures of this character properly demonstrated would be well received by householders and other users of light. This fixture was designed at the time when the bowl fixture was popular and one of the purposes was to show that even an apparent bowl form could be utilized for definite lighting of this character. Other forms, such as those illustrated in Figs. 89, 90, 93, and 94, perhaps are more interesting.

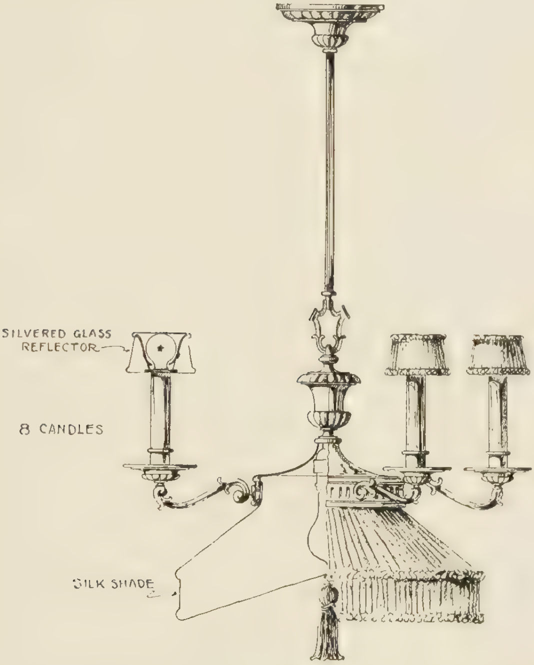

Fig. 97.—A dome for direct lighting combined with decorative electric candles.

Even chandeliers or so-called candelabra may be readily adapted to fixtures which supply a direct component. The equipment which provides direct lighting may be concealed in the chandelier or may be openly combined with it without any attempt at concealment. No better means of supplying what the author has termed the decorative element of light is to be found than that provided by a number of shaded electric candles.

The simplest and most obvious combination is that of the dome and chandelier illustrated in Fig. 97. The dome consists of dense textiles, but its bottom is closed by a layer of thin silk in the form of a squat cone. This diffuses the direct light somewhat and reduces the objection to the shortcomings of the dome of wide aperture, as already discussed. The electric candles are combined as illustrated and in this case are equipped with upright shades on which the textile shades are supported. These small shades increase the indirect component and shield the light sources from the eyes of the diners. When the electric candles are high above the table, their textile shades are not likely to screen the filaments entirely from the eyes of the diners. The inner shades may be of diffusing glass or even of silvered glass, but in the latter case some provision must be made for light to escape, as in this case from the bottom of the reflector, in order that the exterior shade may be luminous. The fixture illustrated in Fig. 97 may be somewhat clumsy in appearance, but it is suitable for an Elizabethan room. Flemish feeling is introduced in the metal work.

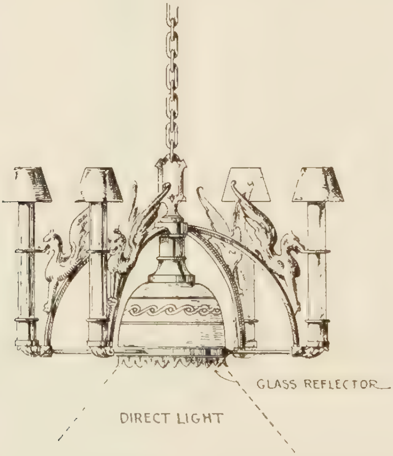

Fig. 98.—A candle fixture to which is added a direct-lighting dome of small size.

The introduction of direct-lighting equipment in the center of a chandelier or so-called "candle fixture" is illustrated in Figs. 98, 99, and 100. In these the housing of the central light source is plainly visible and is justified as a contribution demanded by modern lighting. It is hoped that skilful artists can improve upon these suggestions, for that is their function. The primary purpose of these designs is to illustrate lighting principles desired. The designs must have exteriors, and these have been provided as shown. In such directions the artist finds opportunities.

Surely, if we did not advance by adapting the heritages of the past, the creative artist would be unnecessary. In Fig. 98 the Empire spirit is suggested, although this fixture is quite different from the commonly accepted Empire fixtures. The design illustrated in Fig. 99 is suitable for a Jacobean interior. Figure 100 is of Italian Renaissance spirit.

Instead of employing the large shallow bowl as in Fig. 95, shaded electric candles may be employed as in Fig. 101. The direct component is obtained from the central light source in a metal reflector. The latter also supports the circular metal grill. The electric candles are set at its outer edge. Obviously, the decorative forms and details may be of a number of styles. This particular fixture would be suitable in an interior of English Renaissance, for the decorative details are Italian Renaissance modified by English spirit. The decorative aspect of this fixture could be easily altered to suit an Early English interior of pre-Elizabethan period and various other styles which are now popular.

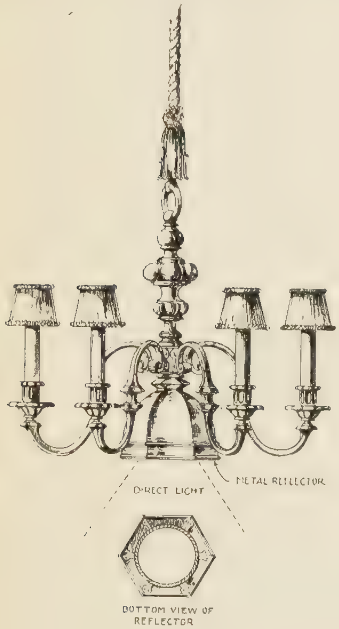

Fig. 99.—A combination of candles and small dome.

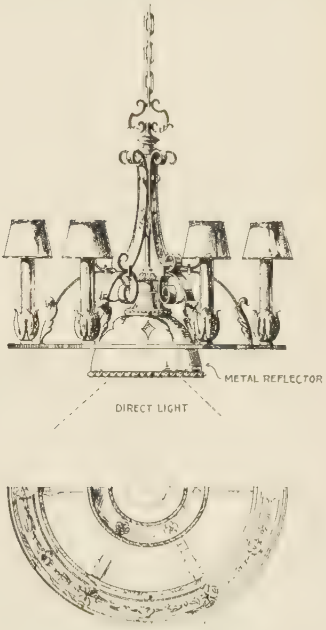

Fig. 100.—A combination of candles and small dome.

A combination of direct and indirect lighting, similar to that illustrated in Fig. 96, to which shaded electric candles are added for additional decorative value, is illustrated in Fig. 102. This fixture could be used in an Early English interior. The Roman arch and the Lombardic Gothic spirit are not out of keeping with such an interior, although the fixture might easily be modified to suit other styles. The lower skeleton drawing shows the direct component and the silvered reflectors for the indirect lighting. The material used for the bottom and the sides of the exterior may be any suitable translucent medium. An old parchment is particularly attractive in an antique fixture of this sort which has been equipped in this manner for modern lighting. The result is eminently satisfactory, because the profile of the fixture has remained unchanged. In the upper skeleton drawing the central aperture and the light source have been eliminated and a semi-indirect lighting effect is obtained instead of the direct and indirect. In this case the bottom might be best constructed of a material more translucent than old parchment.

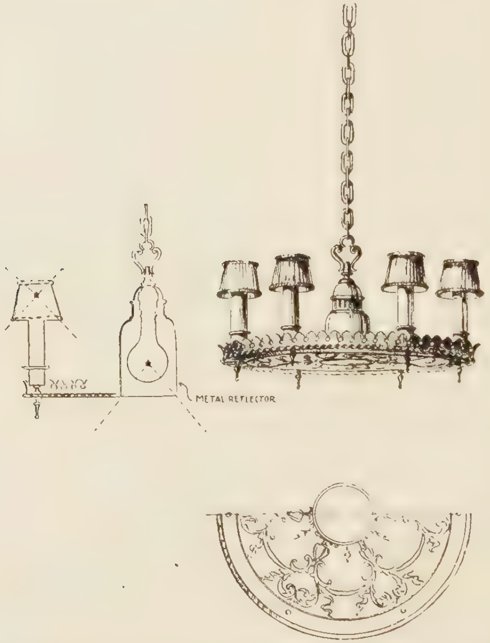

Fig. 101.—A fixture supplying dominant downward light with decorative candles for supplying some general lighting.

A crackled art glass would be suitable for both the bottom and the sides, but the sides could be made much denser by the application of color. Parchment or a textile might be added to the sides, so that the luminosity of this portion would be reduced. However, the complete solution is illustrated in the lower skeleton drawing and the finished drawing on the right.

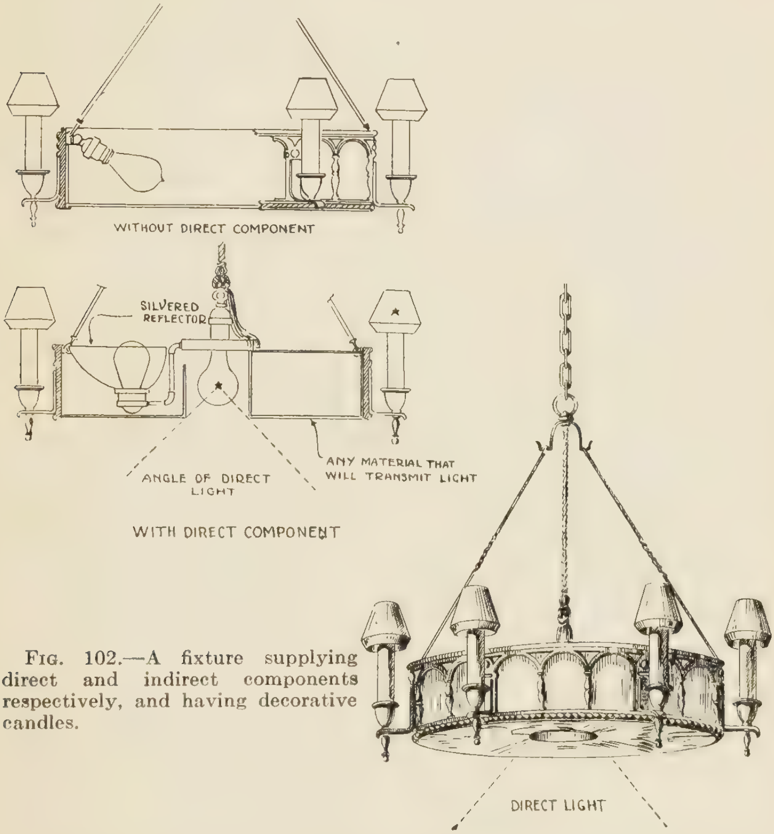

Fig. 102.—A fixture supplying direct and indirect components respectively, and having decorative candles.

The fixture which was adapted as discussed in the preceding paragraph is illustrated in use in Fig. 103. This fixture is a relic of the English Renaissance and is made of iron. It is now finished very lightly in dull gilt. The band of metal work contained nothing inside. It supported the four prickets, which now support the electric candles, and it is supported by the twisted rods as shown. In order to conceal the wiring, a hollow tube was installed vertically in the center. This was wrapped with heavy wrapping twine and touched lightly with dull gilt. A drum of old parchment with the top completely open was installed in the cylindrical ring and the shades of the "antique" candles were made of the same material. The three circuits, each controlling a different lighting effect, provide considerable variety. The combinations of direct and indirect components is very satisfactory for the dining room. In fact, the fixture is now in use in an office where it is quite attractive as well as serving satis-

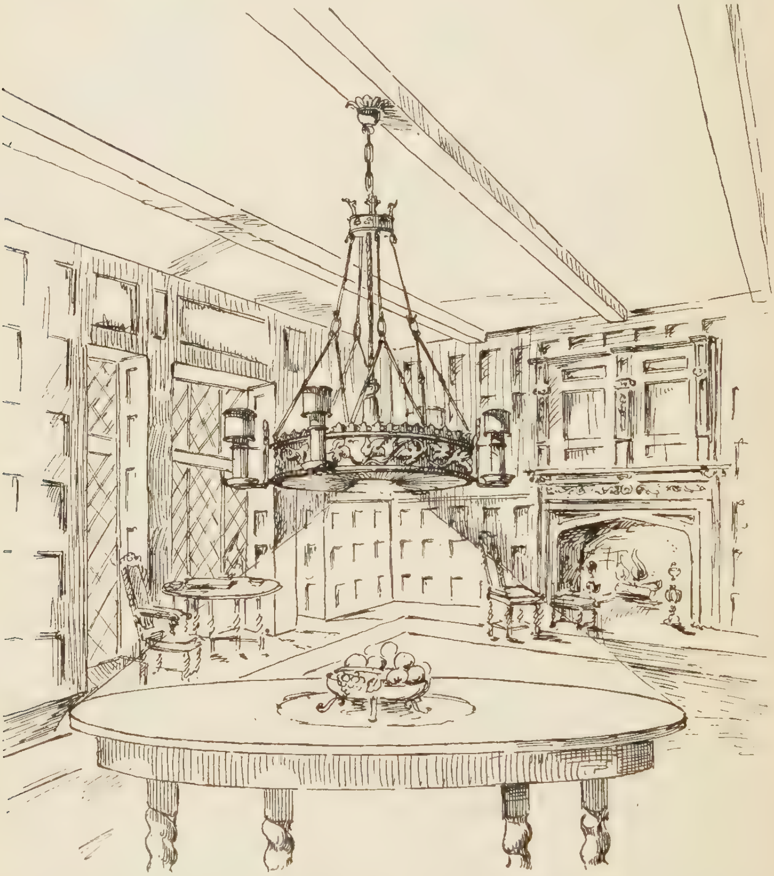

Fig. 103.—An antique iron fixture which originally supported four candles is shown converted for modern lighting. It now supplies direct and indirect components, besides having four electric candles (see Fig. 102).

factorily the utilitarian requirements. The decorative-light element consists chiefly of the four candle shades, although the parchment drum glows faintly through the interstices in the metal work.

A cylindrical shade may encircle a small chandelier or candle fixture, but usually this is a makeshift which, from the viewpoint of light control, is not wholly satisfactory. If, in doing this, the object is to produce an effect more or less similar to that of the pendent dome, it is obvious that several light sources located at a distance from the vertical axis introduce complications. With a single light source on the vertical axis, a symmetrical component of direct light is obtained and the fixture can be hung in such a position that the light sources may be shaded from eyes located at a given distance from the axis. When a cylindrical shade is installed as illustrated in Fig. 104, it is obvious that one light source may be screened from the eyes, while those light sources on the opposite side of the vertical axis from the observer may not be. In order to screen all the light sources, the fixture must be hung lower than if only one light source was used and this was located on the vertical axis. Such fixtures have some applications if rather powerful lamps are to be used. In such a case the use of individual shades might not be practicable. The metal disk near the lamps is intended to screen the most distant lamp from the eyes of the observer. The decorative details in Fig. 104 are suggestive of Italian Renaissance, which is a popular style in lighting fixtures.

The fixture illustrated in Fig. 104 does not provide a dominant direct component if the shade is open at the top. The same is true of Fig. 105, because in this case dense diffusing-glass pans are held in place beneath the lamps. These screen the lamps from the eyes regardless of the position of the latter below the fixture. The glass pans perform the function of a shade and also of a reflector. The indirect component is dominant in this case. In fact, this fixture emits several times more light upward than it does downward. For some purposes it is quite satisfactory, but for the dining room and in other places where a dominant direct component is desired this idea may be introduced as illustrated in Fig. 106. The direct light is obtained from the central reflector as discussed in various preceding cases. In Fig. 106 the glass pans beneath the lamps on the candle stems are not shown. However, the fixture would be more satisfactory for the dining room at least if they were provided as in Fig. 105. They may be fastened to the candle stem or merely held in place by the lamp bulbs.

The so-called bowl-shower fixture perhaps was not designed for a definite lighting purpose, because such a purpose is not evident in practice. In fact, this fixture has not developed any popularity or any definite place in lighting. Furthermore, it is commonly considered to be ugly, and with good reason. Perhaps some artistic fixtures of this sort exist, but they have escaped the author's attention. This book deals with fixtures primarily from the viewpoint of lighting principles and possibilities, and makes no claim to artistic perfection. The artistic exteriors may vary widely, and they are only provided in these illustrations at all because the designs must have exteriors. Notwithstanding this viewpoint, it may be suggested that the design illustrated in Fig. 107 is an artistic one. The form and the decorative details are in classic spirit and an attempt has been

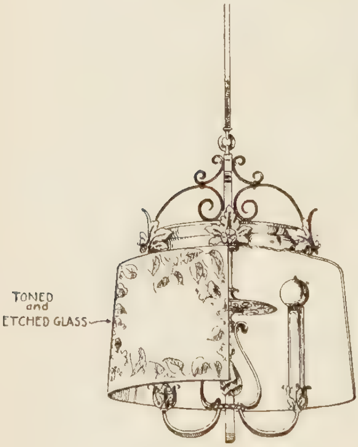

Fig. 104.—A candle fixture enclosed in a large shade.

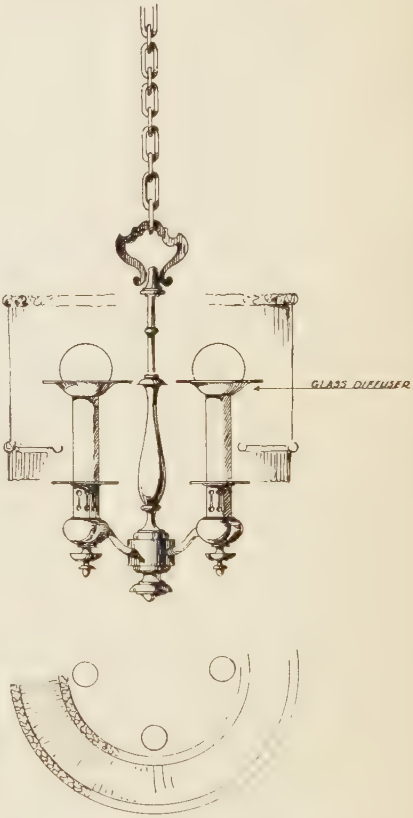

Fig. 105.—A candle fixture enclosed in a large shade. Glass diffusers are shown beneath each lamp.

made in this design to prove that the bowl-shower fixture can be made satisfactory in appearance.

Such a fixture supplies two distinctly different lighting effects. The pendent shades provide a direct component with a slight indirect component diffusely transmitted by the glass shades. Therefore, it is a fixture which has applications in the residential dining room, the living room, and in other places where a direct component is desired. Constructed on a larger scale, it might be used in distinctive shops. The bowl provides an indirect component and a slight direct component diffusely transmitted by the glass. A clear-glass cover is suggested for the bowl in order to keeep out dust and to facilitate cleaning, although the use of the cover is optional. In the dining room, tinted light may be supplied by the bowl as a secondary lighting effect, as discussed in earlier paragraphs. Where such a fixture is desirable or available, the user of light will learn something of the possibilities of lighting effects. It is a type of fixture which is worth keeping in mind, for it has potentiality in lighting.

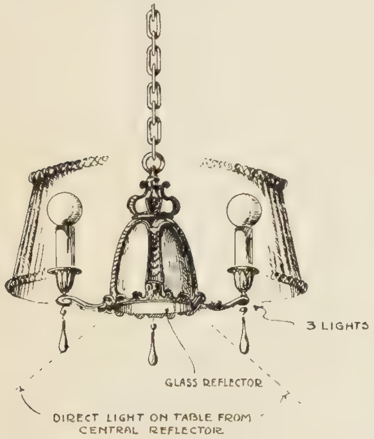

FIG. 106.—A candle fixture enclosed in a large shade, which also includes a dense diffusing glass shade for supplying a direct component.

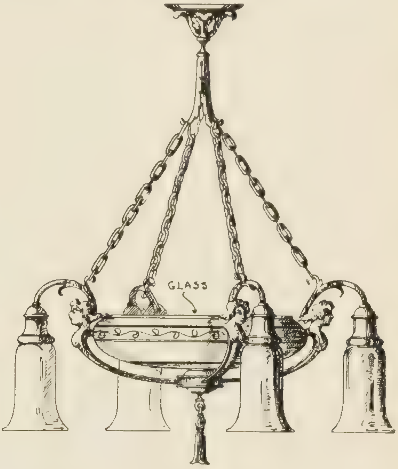

FIG. 107.—A bowl-shower fixture of classic spirit.

Figure 108 illustrates a bowl-shower fixture suitable for an Elizabethan or Jacobean setting. It is more massive than that of Fig. 107 and is clumsy compared with the preceding fixture. Nevertheless, it has possibilities. The glassware should be in harmony with the iron or old-bronze metal work. Certainly, a characterless modern glass, without being toned or decorated in the older spirit, is not suitable. In Fig. 107 the glassware may be delicately diffusing, iridescent, and dainty in color, if colored at all. A plain, thin, iridescent diffusing glass would be quite in the spirit of this fixture. However, the glassware of Fig. 108 should be quite different. A dense somber glass or even a crackled glass of deep-amber would be suitable. The bowl shower has not seen its day, because it has not been given a proper opportunity. Artistic fixtures and a definite purpose for these lighting effects will give this type of fixture the opportunity it deserves.

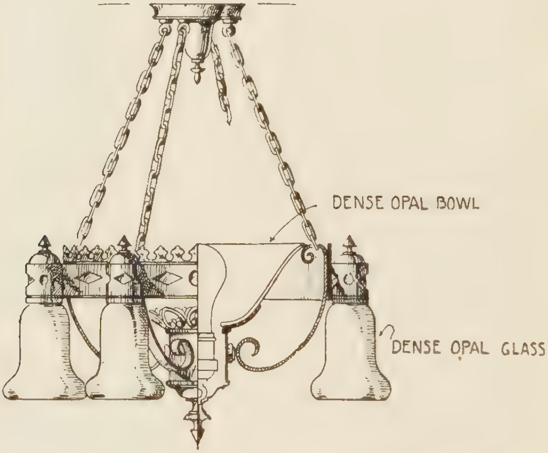

Fig. 108.—A bowl-shower fixture of Elizabethan spirit.

A convenience outlet or a pull-chain switch may be installed at the central point under the dome. If the former is supplied, the tassel or knob may plug into it to complete the decorative design.

The candle fixture has been so popular that it deserves further study. No one can successfully deny that the multiple lights from shaded electric candles are charming. In fact, they provide the best means of obtaining what the author terms the decorative element of light in a fixture. Electric candles alone have scanty possibilities in lighting, however. They provide shaded light which can be directed upward or downward to some degree, but they cannot be said to control light adequately for many modern lighting purposes. Their best use is primarily for decorative quality in combination with other devices for controlling light. Some combinations are illustrated in Figs. 97, 98, 99, 100, 101, 102, and 106, in which a dominant direct component is obtained independently of the electric candles.

The bowl-candle combination illustrated in Fig. 109 provides a dominantly indirect component from the light source in the diffusing glass bowl. Of course, some light is diffusely transmitted downward by the glass bowl. This simple fixture suggests Colonial or Late Georgian spirit in its decorative forms. The bowl-candle fixture has possibilities where a combination of decorative light is desired with so-called semi-indirect lighting. As previously stated, the term *semi-indirect* is meaningless and unnecessary if the lighting effect is specified in terms of direct and indirect components. In Fig. 109 the candles project above the bowl, and if a clear lamp is used in the bowl they will cast unpleasing shadows. Nevertheless, the fixture has a pleasing appearance when the candles project above the bowl in this manner.

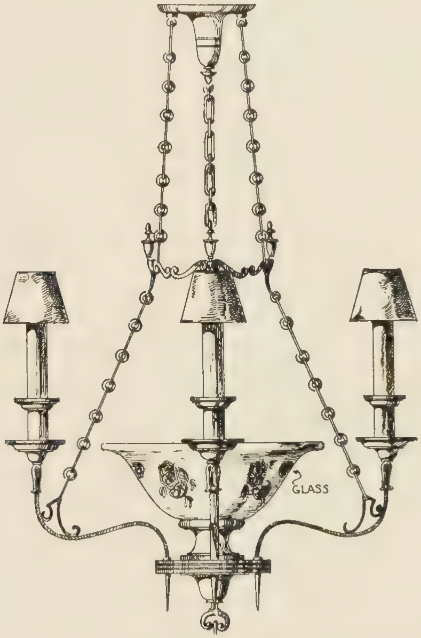

FIG. 109.—A combination bowl and candle fixture.

In Fig. 110 the candles are sufficiently low to avoid objectionable shadows and they are equipped with frosted-glass diffusers at the bottoms of the shades. These screen the light sources effectively. The bowl consists of decorative metal work and a dense diffusing glass. Inside this is a silvered reflector from which some light escapes at its neck. This works its way upward between the silvered reflector and the bowl of diffusing glass and faintly illuminates the latter. If white enamel is applied to the inner parts of the fixture which are not made of diffusing glass and to the exterior of the silvered reflector, a sufficient amount of light will find its way to the inner surface of the glass bowl to illuminate it properly. The decorative forms in this design may be said to reflect the spirit of Louis XIV style.

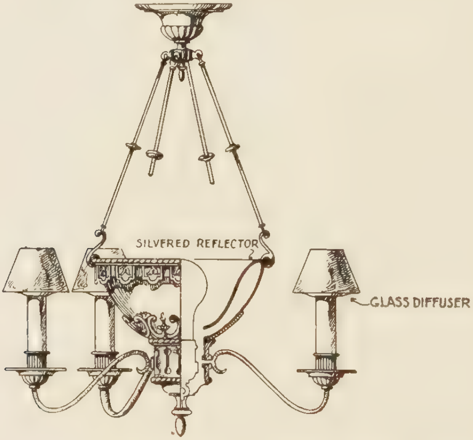

Fig. 110.—A combination bowl and candle fixture.

A number of pendent shades commonly termed a shower may be used to provide the decorative light of a fixture. Of course, they also supply some direct and indirect lighting. They are much more satisfactory in controlling light and in supplying adequate amounts of light than electric candles, but they have some limitations in this respect. We may use them primarily for their decorative quality and combine them with a dome which provides a powerful direct component. Such a dome shower is illustrated in Fig. 111. In this rather massive fixture a large lamp is contained in an efficient reflector concealed in the central housing. This housing may be totally opaque or somewhat luminous by having diffusing glass behind the open-work of the housing. However, in this case the opaque dome is quite satisfactory, because the shower provides an appreciable indirect component besides the direct component which escapes downward. The lamps in the shower shades should be small and frosted and the filament should be high up, as shown. They may be of a warm color. A frosted-glass cover is suggested for the orifice of the central dome. This is dished to give it strength and it may be made of heat-resisting glass if necessary. A skirt of silk and an exterior fringe shields this aperture from view. Such a unit has possibilities in a large private dining room and in distinctive shops. This particular design is in early French Renaissance.

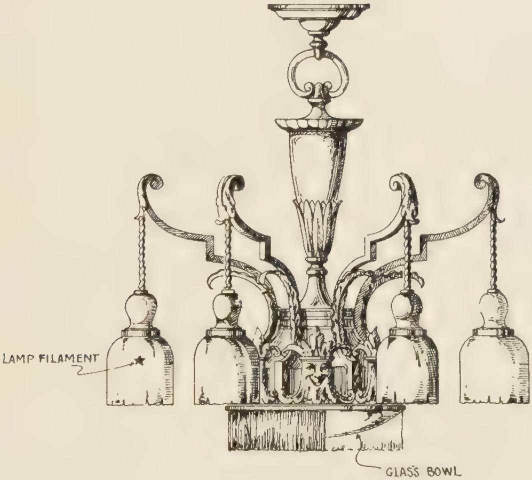

Fig. 111.—A shower in which a dome is concealed for the purpose of supplying a direct component.

A daintier fixture involving the same principle is illustrated in Fig. 112. This suggests the Empire spirit. The dome consists of dense diffusing glass held in the ornamental cylindrical band. A frosted-glass plate covers the lower aperture. This frosted-glass plate does not appear bright when viewed at an angle unless the light source is still directly in the line of vision. In this case the central light source may be located high in the central dome in a socket fastened at the lower end of the central support. This fixture could be used in dining rooms and in distinctive shops of refinement and dainty decoration and furnishing. More pendent shades could be used, but more than four would not seem to be in harmony with the delicacy of this particular design.

Figure 113 is a suggestion along another line. The central vase form consists of dense diffusing glass ornamented appropriately. In itself it does not provide the decorative light which is so well done by multiple candles or pendent shades. However, enclosed-glass light units are recognized as the best solution of many lighting problems. The cover of the vase may be of frosted crystal glass if a more powerful indirect component is desired, but perhaps the appearance is more satisfactory if it is of the same glass as the lower portion. The primary lighting is obtained from this central enclosing glass. The shaded electric candles, with glass diffusers closing the bottoms of the shades, are used to screen the candle lamps from view. This design is an attempt to provide the charm of decorative light by means of electric candles which an enclosing-glass lighting unit does not possess sufficiently alone. Many distinctive shops, for example, are best illuminated by enclosing-glass fixtures, but their furnishings require fixtures of greater decorative quality. In the direction suggested in Fig. 113 lies a solution of many of these problems. This particular design is in the Georgian spirit.

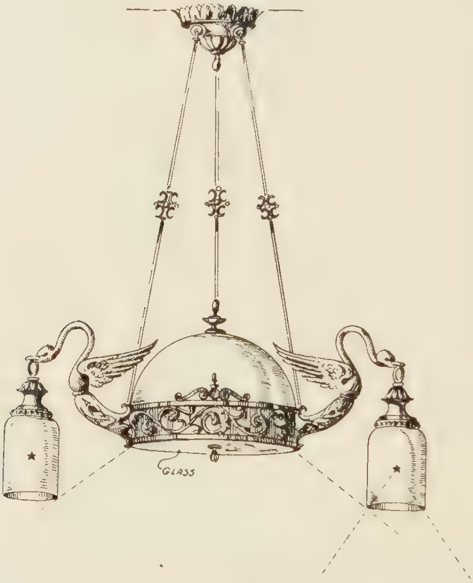

Fig. 112.—A dome to which are added small pendent shades for decorative purposes.

It has been obvious in preceding discussions and illustrations that delicate glassware is needed, particularly for candle fixtures.

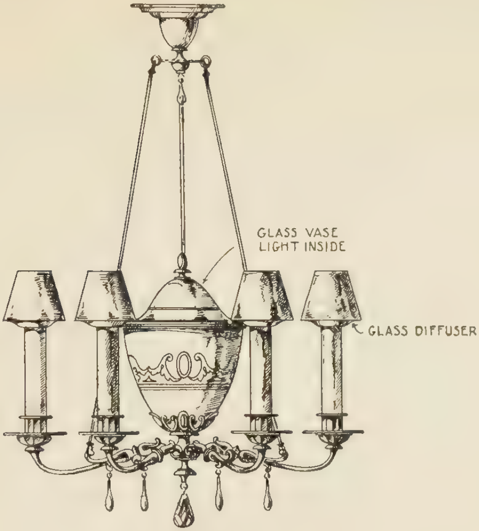

FIG. 113.—A fixture of enclosed diffusing glass, combined with electric candles for decorative purposes.

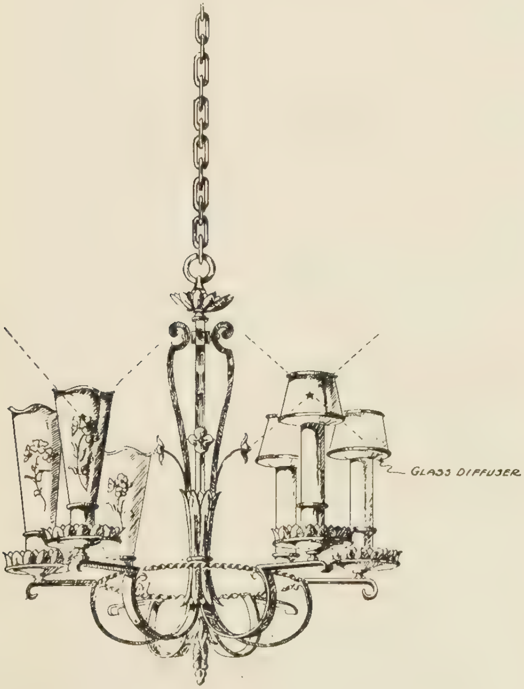

FIG. 114.—Suggestions for delicate shades.

Some suitable glass shades are available for the more delicate fixtures, but the supply is scanty at present. It is not the intention at this point to discuss decorative glassware, but in closing this chapter it seems necessary to bring this point to the attention. By no means have we exhausted the possible forms which are applicable to candle fixtures, and certainly the ingenuity of the artist will eventually provide the needed shades. Figure 114 shows a modern candle fixture in the spirit of Italian Renaissance. The metal work may be of iron or bronze and in the former case the metal flowers might be colored. On the left is a more or less original form which has not been employed. It could consist of parchment, mica, or delicate glass. The candle stems could be short, and tubular lamps several inches long could be used. It is true that this has no prototype in past periods, but the author has expressed himself clearly on this point. On the right we may compare delicate shades of glass, parchment, or mica with diffusing-glass bottoms on the usual candle stems. Certainly, there are possibilities in these directions which have not been developed.

In closing this chapter, in which it has been the aim to discuss decorative fixtures designed for definite lighting purposes, it should be emphasized that the subject has not been exhausted. In other chapters, many modern ideas are to be found dressed in decorative exteriors. Even in all the chapters combined it is not hoped to present all the possibilities. The aim of the book is chiefly to blend science and art in lighting. This is sorely needed, for modern lighting possibilities demand new fixture designs. But all the author hopes to accomplish is to open up new avenues of thought which may appeal to the artist. No apologies are made for the decorative portions of the suggestions presented in these illustrations. This is a feature which can be executed to the satisfaction of anyone. The creation of fixtures which embody some of the proper lighting principles and do justice to modern artificial light is the primary purpose of these chapters. From the decorative viewpoint prototypes of bygone periods have been sought for, but, not finding them, it has been necessary to originate new forms. This is perfectly defensible, but we need the sympathy of the creative artist to carry the work to perfection. The slavish imitator is of no help and his criticism is valueless. However, it is hoped that these chapters may awaken him to the possibilities of creating new forms which may be used as vehicles for modern lighting.

CHAPTER XVII

DECORATIVE LANTERNS FOR MODERN LIGHTING

The term *lantern* as applied to lighting equipment is indefinite, but at least it suggests something quite different from the chandelier and other general classes of lighting fixtures. Perhaps in the strictest sense, a lantern consists of a housing in which one or more light sources are installed, the light being emitted through openings usually filled with transparent or translucent media, such as glass or mica. Owing to associations, we are usually better satisfied with a lantern which superficially appears to contain one light source than with one in which several light sources may be distinguished at various levels. This is not an invariable rule, but it is worth consideration. If a number of light sources are to be used inside a lantern and if they are to be more or less visible, a more satisfying appearance is produced by placing them on the same level or by arranging them symmetrically at different levels. These statements apply to the light sources which make the lantern luminous and which are essential in suggesting a lantern.

When light sources were flames, transparent media could be used in the panels, but modern light sources are so brilliant that diffusing media are necessary for comfortable and artistic lighting. Even frosted electric bulbs are usually too bright in these fixtures as in chandeliers, so that diffusing media should be used in the housing. Furthermore, such translucent or diffusing media conceal the modern light source and aid in producing the illusion of a lighting device of a bygone period, which is so often desirable in the residence, club, church, and elsewhere. But in modern lighting these light sources are often of importance only in providing what we have termed the decorative element of light. In many cases the lantern provides an excellent place of concealment for accessories which provide direct and indirect components of light by means of which the primary lighting effect is obtained. In the lantern we have an excellent example of the possibilities of adapting an old device to modern lighting, that is, of concealing modern lighting equipment in art forms of bygone period styles.

We may find many lanterns in which light is not definitely controlled. The light is emitted from the sides and it serves to illuminate the surroundings haphazardly. Usually, little light is emitted downward, so that the lantern often fails to do its work well. With the advent of the electric filament lamp the bottom of the lantern can be transparent, so that the floor or the steps can be well illuminated. Notwithstanding this possibility, many lanterns are still designed with opaque bottoms, so that they are not providing the best lighting in these cases. Figure 115 shows a modern lantern of Colonial spirit. This may be quite satisfactory for corridors, hallways and reception halls where only a small area is to be illuminated. The light is emitted largely toward the walls and ceiling and the floor is illuminated chiefly by the light reflected from the surroundings. Unfortunately, clear crystal glass was commonly associated with decorative candlesticks and oil lamps during the Colonial period and it is difficult to avoid its use with modern electric lamps. This is one of the great disadvantages of using the Colonial style in modern lighting. If the glass is frosted, an improvement is achieved, but a modern light source surrounded by a frosted crystal-glass shade is still harsh and even glaring. If the Colonial fixture is to be satisfactory, something must be done toward adopting effective diffusing media for the shades. In Fig. 115 the inner shade might be made of thin opal glass and the outer panels might be of frosted crystal glass. Frosted or opal glass might be used for both. This illustration is introduced for the purpose of focusing attention upon the necessity for using diffusing media in modern lanterns (see Fig. 10).

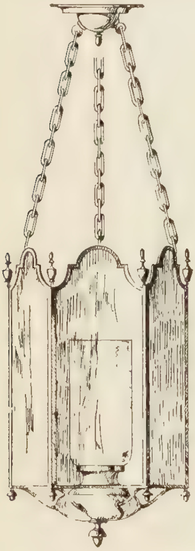

Fig. 115.—A modern Colonial lantern.

Such simple adaptations from the past are often glaring because all or much of the useful light must be emitted from the sides of the lantern. Therefore, if it is to be a suitable fixture for modern lighting, the sides of the lantern must consist of suitably diffusing glass. However, if the lantern is used as a place of concealment for equipment which emits the primarily useful direct and indirect components, the sides of the lantern need not emit any more light than is desirable from the decorative viewpoint.

The simplest lantern would consist of an external shell of diffusing glass with the top and bottom open, as illustrated in Fig. 116. This would be quite efficient and much light would be emitted directly upward and downward. By altering the dimensions of the shell and the position of the light source, the angular extent of the components emitted directly upward and downward can be controlled within wide limits. Owing to the specular reflection of various surfaces, such a fixture would be open to objection. That is, bright images of the filament of the lamp would be reflected by polished surfaces, such as the ceiling, table top, etc., which receive light directly from the filament. The use of a frosted lamp would improve matters some. It is seen that frosted or opal glasses could be used in the upper or lower apertures, thereby controlling the relative amounts of the direct and indirect components. In Fig. 116 we have the general principles of the lantern, but without a complete independent control of direct, indirect, and decorative components of light. Complete independence of these factors is shown in other illustrations.

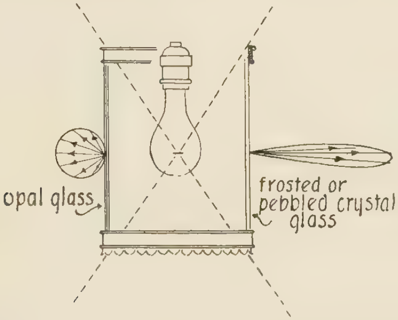

FIG. 116.—Illustrating a glass cylinder with open top and bottom.

One of the simplest types of lanterns in which the direct and indirect components are independently controlled is illustrated in Fig. 117. This could be a pendent lantern as well as a wall fixture. This particular one was designed first with a bracket for fastening to the wall. It is made of wrought iron with diffusing mica panels and is quite suitable for Early English and Spanish interiors. Obviously, the design and the materials may be such as to be suitable for a great variety of interiors and exteriors. The direct component is supplied by means of a lamp in an asymmetrical silvered reflector. The opening may be covered with clear, pebbled, frosted, or ribbed glass, depending upon the requirements. These glasses scatter light sufficiently to eliminate striations and do not alter the distribution too much for many cases. Ribbed glass spreads the light more or less in the direction perpendicular to the ribs and, therefore, has many applications in fixtures. This downward component is useful in illuminating a picture on the wall, an object, the floor, or steps. Obviously, it has many applications where ordinary wall lanterns have been used; however, it has other applications in interiors. The ordinary lantern, which emits all or most of its light from its sides, has a very limited usefulness in modern lighting, but the lantern illustrated in Fig. 117 has many uses where an object or area beneath the fixture is to be effectively illuminated by controlled light.

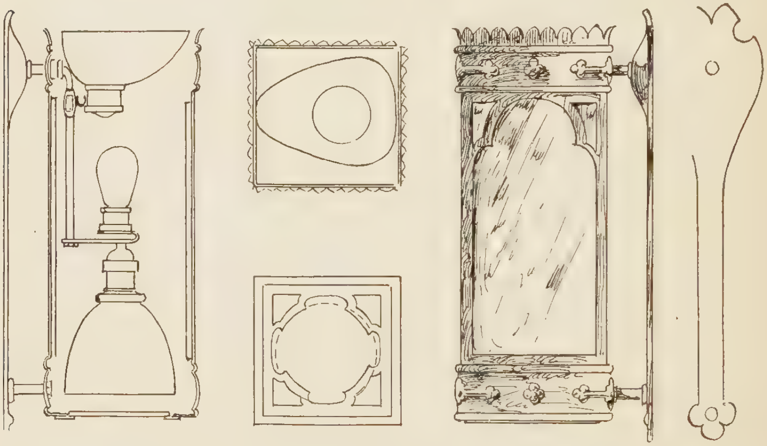

Fig. 117.—A wall lantern which provides direct and indirect components, the panels of the lantern being illuminated independently.

The upward component is also emitted from a lamp in an asymmetrical reflector of silvered glass. This is covered by a plate of clear glass to keep the dust out. Other glasses may be used as already discussed. The decorative component of light is emitted by a light source of low intensity, so that the diffusing panels merely glow. This glow vitalizes the lantern, so that it is satisfying esthetically. Diffusing mica, parchment, decorative glass, and even textiles may be used for the panels. In the wall lantern the panel next to the wall may be opaque, or nearly so. With a light source of low candlepower, the panels need not be perfectly diffusing. In fact, it is often more satisfactory from an artistic viewpoint to have a condition where the position in the light source is discernible. However, this cannot be recommended when the panels emit a great deal of light, as in ordinary lanterns. The equipment in the portion of the interior of the lantern which is enclosed by the translucent panels may be painted with white or aluminum paint in order to conserve the small amount of light emitted by the small light source. This also tends to improve the appearance of the panels. Attention to such minor details is worth while. The three light sources may be independently controlled, although, of course, the panels should be illuminated whenever the lantern is in use. Obviously, either the indirect or the direct component may be omitted where it is not desired. Those who consider lighting in terms of modern possibilities will find many applications similar to those suggested in and by Fig. 117.

A type of lantern which is very useful and appropriate in certain Gothic churches is illustrated in Fig. 118. In churches whose ceilings are of low reflection factor, due to stained wood and other dark-colored materials, it is wasteful to permit much light to escape upward. Furthermore, such a lighting effect would be unsatisfactory from every psychological viewpoint. In Fig. 118, it is seen that silvered-glass reflectors containing light sources of high candlepower emit powerful components of light downward. The openings of these may be closed with crystal glass, which may be clear, pebbled, or even lightly sand-blasted or acid-etched. It is often desirable to diffuse the light in this manner in order to reduce the annoyance due to images of the light source reflected from polished surfaces.

If there are a number of reflectors in the lantern, each of which supplies a direct component, it is obvious that independent control of each makes it possible to vary the intensity of illumination on the horizontal plane below to suit the requirements. This is quite desirable in churches and in some other places where such lighting equipment may be used. Of course, this may also be done by the use of dimmers. It is advantageous in some cases to have the aperture of the direct-lighting reflectors

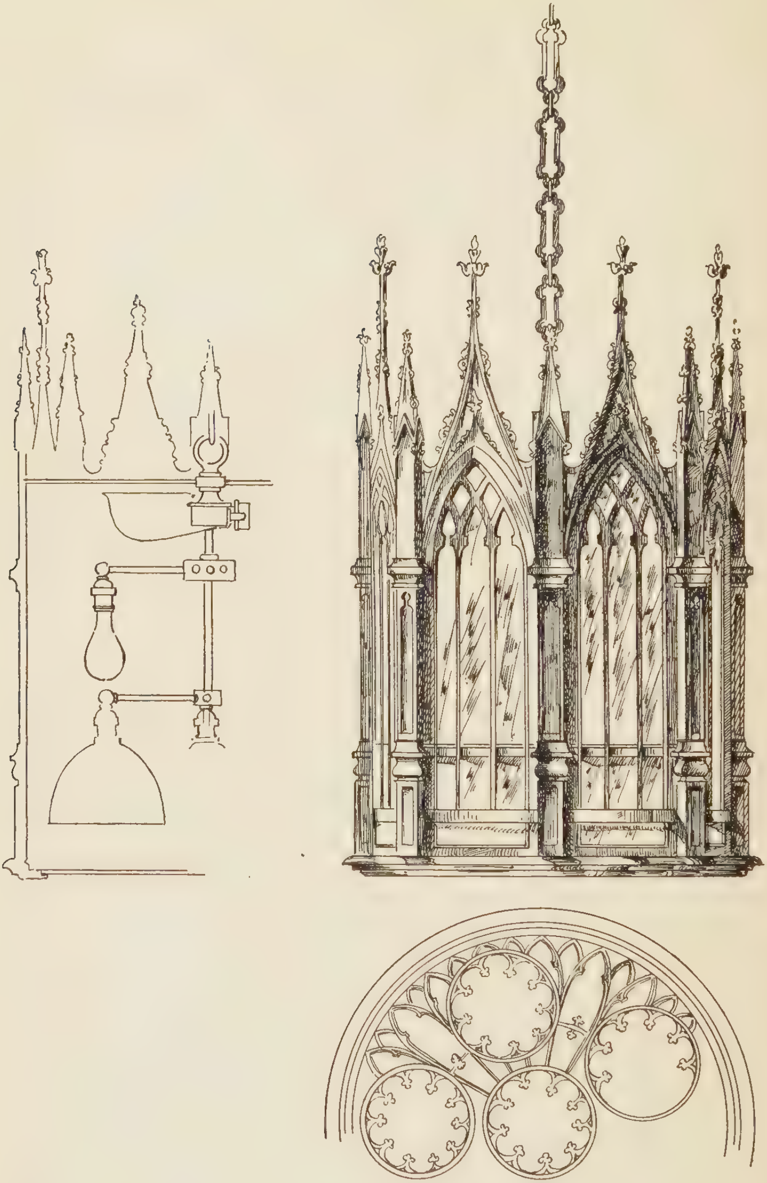

Fig. 118.—A Gothic lantern supplying a powerful direct component. Its panels are illuminated independently and a component of indirect light can also be supplied.

a few inches above the glass, thereby permitting scattered light to illuminate the glass when the direct-component lamps are not lighted.

The direct-lighting reflectors are located so that their apertures are several inches above the glass bottom of the fixture. This is done so that when only the lamp in the central direct-lighting reflector is operating the areas of glass underneath the other reflectors are more or less luminous. Reflectors are indicated for obtaining the slight amount of indirect component which is desired in even the dark-ceilinged churches. They may be as large as desired, so that a powerful indirect component may be obtained where conditions require such a lighting effect.

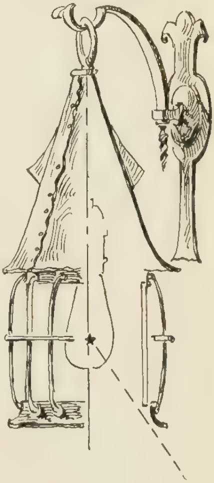

FIG. 119.—A simple lantern with open bottom.

Let us return for a moment to the simple lantern illustrated in Fig. 119. This type is usually obtainable without difficulty, but too often it contains clear-glass sides and an opaque bottom. For the purposes for which it is usually intended a pebbled or otherwise "obscuring" glass is more desirable than clear glass, because such a glass conceals the modern electric lamp and diffuses the light somewhat. A further improvement would result if the inner surface of the glass were sand-blasted or if the glass were slightly "milky" besides being pebbled. A warm yellowish tint also adds an interesting touch, although if the glass is colorless the warmth of color may be obtained by using an electric lamp with a bulb tinted as desired. A flame-tint is now generally available in electric lamp bulbs. Often the more important feature of such a lantern as this is the transparent bottom from which a direct component of light is obtained for illuminating steps, floor, or ground beneath the lantern. This glass may be similar to the glass in the sides of the lantern. Usually, a pebbled glass is sufficient. The pebbling scatters the direct light to some extent and reduces the conspicuousness of the boundary of the direct component of light.

Figure 120 illustrates an apparently simple wall lantern, which is more useful than such a lantern usually is. The front panel consists of a decorative diffusing glass. The sides, top, and back of the lantern are opaque and should be painted inside with white or aluminum paint. The bottom is closed with a pebbled crystal glass. Inside is a prismatic glass reflector located as shown. Such a reflector may be obtained in various designs, so as to distribute the light as desired in a downward direction. The light may be concentrated in a beam or spread symmetrically or asymmetrically. This glass reflector has the advantage in this case of transmitting enough light to make the front panel of the lantern luminous. In order to avoid striations from the glass prisms of the reflector, the exterior of the reflector may be slightly acid-etched. This transparent reflector avoids the necessity of an auxiliary lamp for illuminating the front panel of the lantern. It is obvious that color may be used in the front panel without altering the useful downward component.

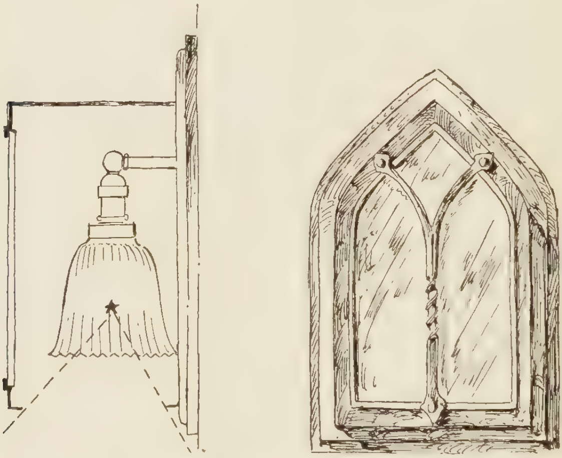

FIG. 120.—A wall lantern with prismatic glass reflector and open bottom.

A decorative lantern in Empire style is illustrated in Fig. 121. Such a lantern containing electric candles and enclosed in a cylinder of clear glass is not uncommon. It has many applications, in various sizes, in residences, hotels, and other buildings. But why not make it more useful by adding an efficient reflector which provides a downward component? This has been done in this design. A silvered-glass reflector is covered with an ornamental husk of metal, as illustrated. This husk could be made of translucent diffusing material. In such a case a prismatic-glass reflector or even a dense opal-glass reflector could be used.

The opening under this reflector could be covered with frosted or pebbled crystal glass. The electric candles may be equipped with shades or in some large interiors electric lamps with frosted bulbs may not be objectionable.

An interesting fixture which might be classed as a lantern is illustrated in Fig. 122. The decorative details are of French Renaissance. A row of electric candles encircles an inner structure, which houses a silvered reflector in which an electric lamp is installed. The latter supplies the direct component. The rod which supports this inner reflector and socket is adjustable, so that the angle of the cone of direct light can be controlled. Individual shades could be used on the candles, but in this case a cylindrical shade encircles the lamps on the candle stems. Here again we may venture to suggest that the fixture is beautiful. Polished or dull mirrors might be used for the panels of the inner housing, or any other means may be used to aid in vitalizing the fixture. If mirrors are used, the encircling shade should be designed not only for screening the light sources, but also their mirrored images. Such a fixture has many uses, such as in distinctive shops, entrances to hotels, over stairways, in hotel lobbies, in churches, and in various large interiors where a powerful direct component is useful. Usually, a frosted lamp should be used for the direct component or the opening should be closed with a frosted or pebbled crystal glass. With a clear lamp, the shadows of the scalloped opening would be very pronounced and unsatisfactory. In fact, it would be well to avoid such a deeply scalloped edge as is shown for the direct-light opening. Obviously, the panels of the inner housing could be

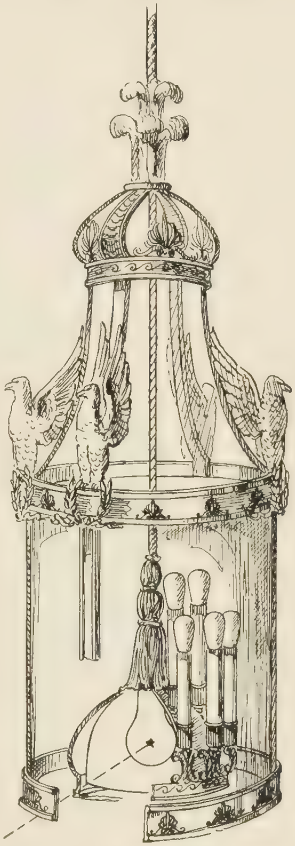

Fig. 121.—An Empire lantern which provides a powerful direct component. The candles are added for their decorative value.

of dense diffusing glass and they could be illuminated by a small lamp or by light escaping through the inner reflector. Many variations of these details are possible.

Prismatic glassware has many applications where light is to be controlled in distribution. The reflectors, consisting of prisms of clear glass, control light very accurately and transmit a slight amount of it. This transmitted light is very useful sometimes in lanterns and other fixtures which have panels or other areas which should be slightly luminous. The designer of modern lighting fixtures will do well to keep in mind this property of prismatic glassware. Of course, a shade of dense diffusing glass will transmit enough light for this purpose, but it does not control light as accurately as a prismatic reflector.

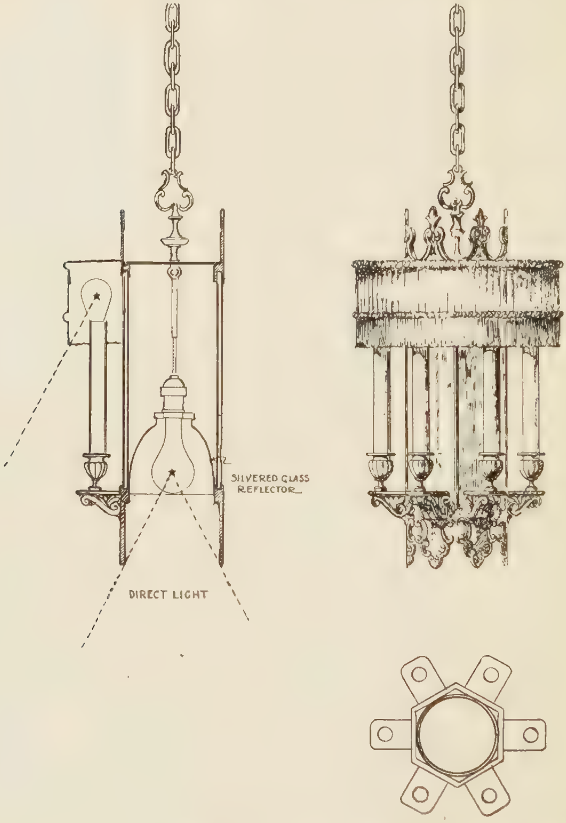

Fig 122.—A fixture supplying a direct component as well as having decorative electric candles.

Figure 123 illustrates a modern lighting fixture consisting of prismatic glass. We have merely given it some bespangled clothing. The lower aperture is covered with frosted crystal glass, thereby rendering the cut-off of the direct component less harsh. This also encloses the fixture according to best practice, thereby eliminating ventilation and at the same time preventing the intake of dust. This lighting unit is efficient and appliable to those places where a component of direct light is desired along with general lighting. The decorative details are suggestive of classic Greek art. Such a fixture could be used in distinctive shops and in large interiors where some sparkle is desirable.

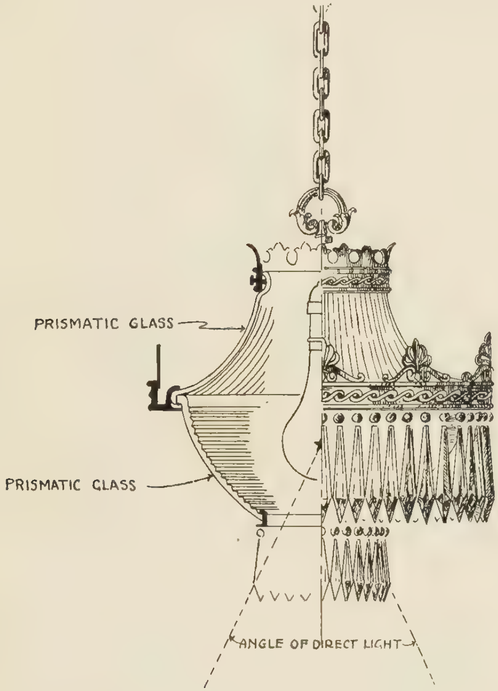

Fig. 123.—A commercial prismatic fixture, decorated with crystal-glass ornament and having an etched crystal-glass bottom through which direct light is emitted.

A useful lantern of classic details is illustrated in Fig. 124. Direct and indirect components are obtained by the silvered-glass reflectors as shown. These may be controlled by means of separate circuits and switches and the central lamp which illuminates the panels is connected to both circuits. The silvered reflector which supplies the downward component is located slightly above a circular piece of frosted clear glass which is slightly convex to give it greater strength. Some light escapes between this bottom glass and the reflector above it and this helps to illuminate the panels. The central lamp may be colored so that the light which illuminates the panels is of a flame-tint.

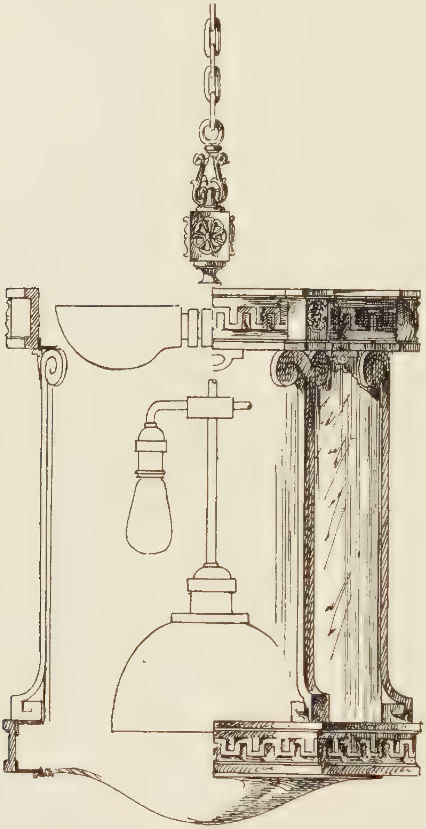

FIG. 124.—A lantern having luminous panels and supplying direct and indirect components independently.

This is a feature worth applying to all lanterns, because it adds greatly to the effectiveness of the illusion desired. The lantern illustrated in Fig. 124 was designed to illuminate a stairway well containing three flights of stairs. The powerful direct component of light projected downward by the silvered reflector adequately illuminates all the steps and the indirect component illuminates the ceiling and the upper hall. This lantern is efficient and effective in such places and may be used in many other places.

The possibility of utilizing devices for controlling light in decorative fixtures are almost unlimited, but relatively little use has been made of them. Some of these applications have already been suggested, but let us assume an extreme case. Suppose we have a rotunda, with a high ceiling and a square, hexagonal, octagonal, or circular plan, having a frieze of mural paintings to

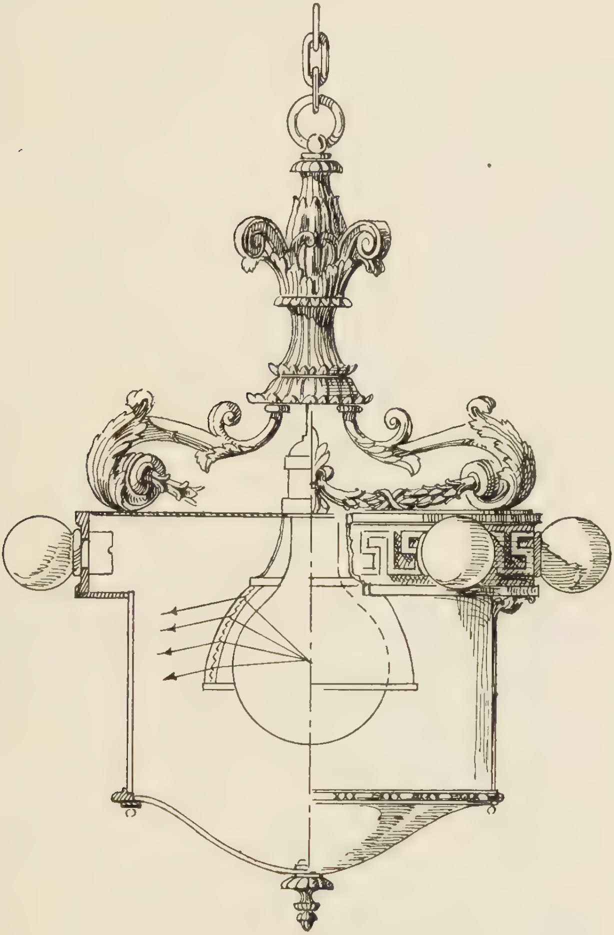

FIG. 125.—A lantern in which a street-lighting reflector is incorporated for the purpose of distributing light primarily in a direction slightly below the horizontal.

be illuminated. Doubtless, the architect or fixture designer would not think of invading the street-lighting field for a device for use in the central lantern or chandelier. However, the refractor of prismatic glass is an excellent device for illuminating the frieze. This may be concealed in a decorative fixture, as suggested in Fig. 125. This refractor concentrates much of the light from the lamp within it in a narrow zone just below the horizontal plane through the light source. Thus, a band of light of high intensity would be emitted toward the frieze of mural paintings if the fixture were hung so that the refractor was of a proper height, which would be slightly above the level of the top of the frieze. If the refractor could be inverted, the lantern would be hung at a level slightly below that of the frieze. If it were necessary to reduce the harshness of this band of light emitted in a general horizontal direction, the sides of the lantern could be made of pebbled or slightly roughened crystal glass. The remainder of the fixture could be as ornamental as desired. Usually, it would be necessary to illuminate the floor. In such a case, a direct-lighting reflector could be concealed, as in the other lanterns already described. Such a refractor could be concealed in a chandelier or any other fixture. If the fixture were to hang high in a large interior, even frosted lamps could be used for the decorative-light element. This is a solution of one of the many difficult problems in connection with mural paintings and other wall decorations which should be highly illuminated.

Many problems of illuminating pictures may be solved by means of lanterns supported on pedestals and elsewhere. The lanterns can have denser panels on the sides away from the picture than on those toward the picture.

In the construction of lanterns as well as other fixtures, the concealment of scientific accessories by means of a decorative exterior calls for ingenuity in the use of motifs or art forms suitable for the particular period style involved. Many forms of bygone periods may be readily adapted to the purpose of clothing lighting accessories. In previous chapters many of these forms have been suggested. Sometimes it will tax the designer's ability to the utmost to find and to adapt a motif which is suitable in every respect. Obviously, in the limited space of a book we may include only a relatively few suggestions, but it is hoped that these will arouse associations which may result in further adaptations and applications.

We have discussed a lantern (Fig. 118) containing modern lighting equipment and producing a desirable lighting effect in an efficient manner for certain Gothic churches. Pretentious churches are quite generally of certain period styles and suitable motifs are not difficult to find. The ancient mosque lamp may be readily adapted to conceal modern lighting equipment. The censer is a motif which may be widely used for this purpose and its use is not limited to churches. However, if the decorative exterior is made of openwork metal, it is necessary to have a more or less diffusely transmitting lining in order that this metal tracery may show to advantage. It is not difficult to line the interior of this metal openwork shell with pliable media such as textiles and parchment; however, these are not sufficiently durable to warrant their use where glass is satisfactory. When glass is used, some limitations arise as to the form of the metal shell. If the chief areas of the metal shell are flat, as would be the case

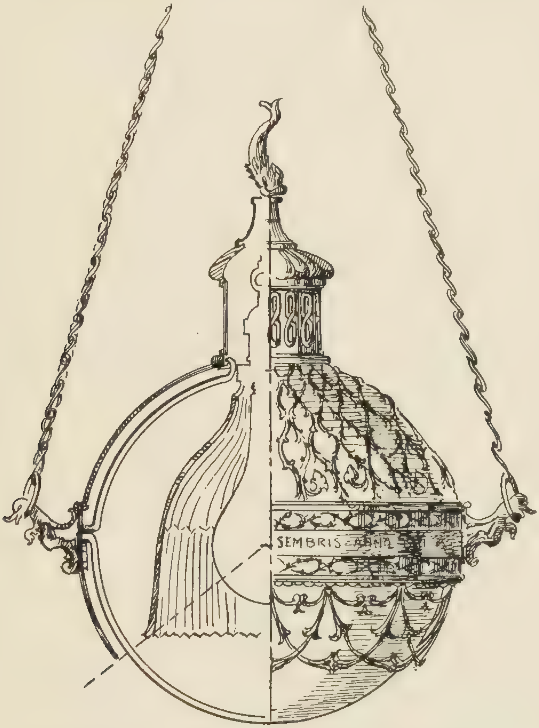

Fig. 126.—A suggestion for an effective direct-lighting fixture in which the censer is used as a primary motif.

in a hexagonal or octagonal form, it is easy to insert panels of glass. It should be understood that there is much loss of light due to the absorption of the metal portions, even if they are painted white inside. The areas through which the utilitarian direct or indirect components pass may be as free from metal work as the design will permit.

Figure 126 shows a fixture of censer motif in which scientific lighting equipment is concealed. A reflector of prismatic glass is installed as shown within a two-piece sphere of crystal glass frosted inside. It will be noted that the cone of direct light, indicated by the broken line, is so located that its cut-off falls at the bottom edge of the exterior metal work. The prismatic reflector transmits some light, so that the sand-blasted sphere is illuminated, thereby providing a luminous background against which the ornamental metal work will be advantageously seen. This provides an efficient direct-lighting fixture which may be as

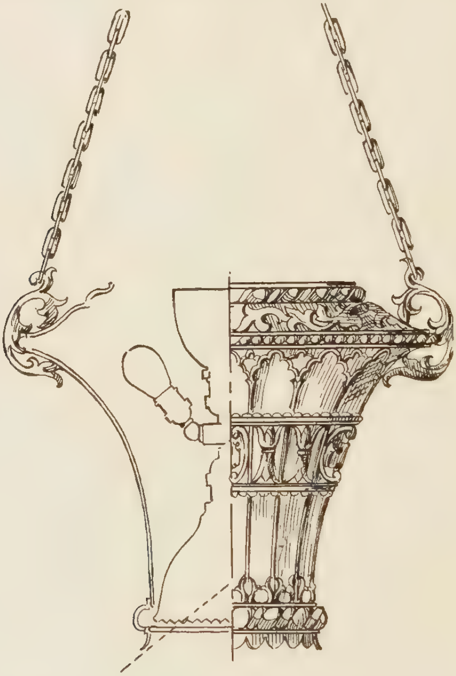

Fig. 127.—A suggestion for a fixture which supplies direct and indirect components independently. The metal open-work is seen against a background rendered luminous by light sources supplied for the purpose.

decorative as desired. It is quite suitable for certain churches and other interiors. Striations from the prisms of the reflector may be eliminated by etching the exterior of the reflector, as is commonly done.

The censer motif may be varied in many ways to conceal the lighting equipment. Another suggestion is illustrated in Fig. 127. Here we have one reflector emitting a downward component and one emitting an upward one. These may be of silvered or prismatic glass. A luminous background may be provided for the metal work by inserting fireproofed textiles. This is a less difficult solution when odd shapes are employed than attempting to use frosted glass. In Fig. 126 a spherical shape was used purposely, so that a glass sphere could be used. Hexagonal and octagonal sides have the advantage of making it possible to use flat glass panels. Of course, if the fixture manufacturer is willing to make glass panels of intricate forms, it is possible to utilize diffusing glass panels. In Fig. 127 three or more small lamps are used to illuminate the background against which the metal work is to be seen.

The foregoing are a few examples of the possibilities of obtaining modern lighting effectively and efficiently from decorative fixtures of the lantern type. Many other designs should occur to those interested. Certainly, here is a field calling forth all the ingenuity which anyone may possess, a field illustrating very well the desirability of the cooperation of the lighting expert and the artist. It should encourage the artist to learn more of the wonderful possibilities of combining science and art in the design of lighting equipment.

A problem of lighting an art museum suggested to Ward Harrison and the author the idea of a "universal" lantern, as illustrated in Figs. 128 and 129. There is a tendency in art museums to show furniture, cases, sculpture, paintings, and other objects of the same period in the same room. Furthermore, in a large museum the character of the exhibit in a given room cannot always be determined beforehand, and it does not necessarily remain unchanged. In such rooms it would be desirable to have a lighting fixture which could be adjusted so as to give light predominantly on the walls or directly downward as desired and to supply the correct upward component or amount of indirect lighting suitable for each case. As already stated, the lantern seemed to offer the best solution, because it could be designed so as to be decorative and of the same appearance throughout various rooms, regardless of the different lighting effects it might be supplying in the various rooms.

The lantern illustrated in Fig. 128 may supply direct and indirect components, as already described in Figs. 117 and 124. In the room where the direct component is not desired, the bottom of the lantern could be opaque and the direct-lighting reflector could be omitted. However, provision could be made for installing a frosted or pebbled crystal-glass bottom beneath the reflector when the exhibit was such as to require direct lighting. Some indirect lighting would likely be desirable in all rooms. An asymmetrical reflector could be installed as shown and at the proper angle so that it would direct light toward the walls for illuminating paintings, tapestries, and other objects displayed on the walls. These lanterns would be hung at a proper distance from the walls and the panels facing the walls would consist of slightly diffusing glass, such as frosted crystal glass or very light-density opal glass. The remaining panels would consist of very dense glass, so that they would appear

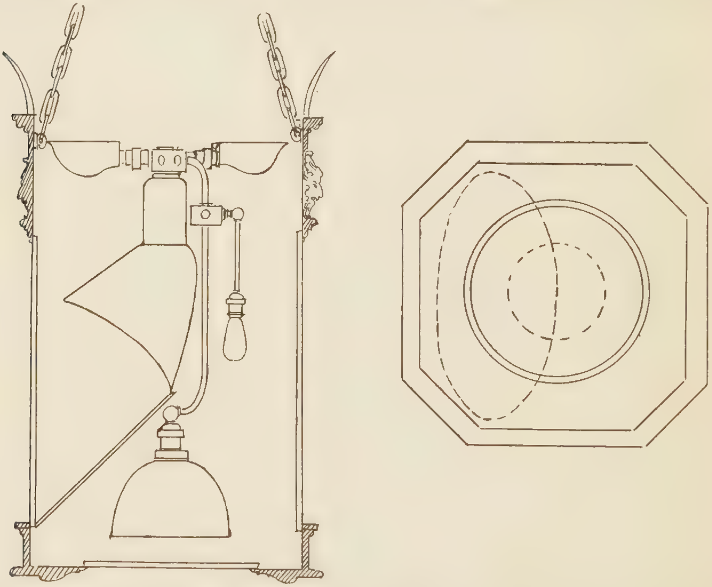

Fig. 128.—A "universal" lantern from which direct and indirect components may be obtained and also a powerful component may be directed from the side for illuminating paintings and other objects on the walls. A horizontal section is illustrated at the right.

barely luminous by the light of an auxiliary lamp or by light spilled or transmitted by the reflectors or reflected by the panels of light density. Shields could be arranged so as to confine the light to the panels as desired. In a corner the panels facing the two walls would be of slightly diffusing glass. It seemed that an octagonal lantern with unequal panels, as shown by the cross-

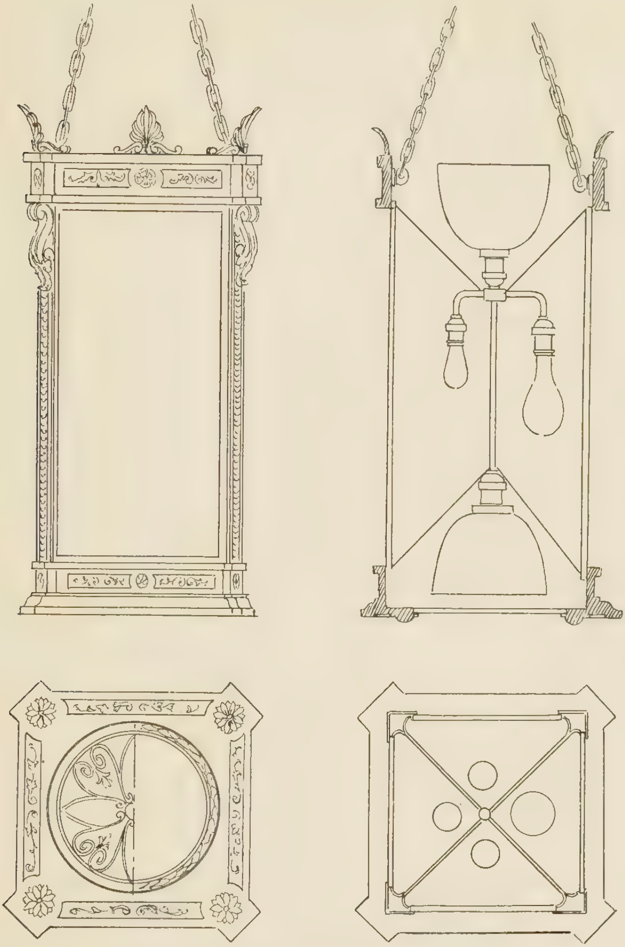

Fig. 129.—A "universal" lantern supplying direct and indirect components and having four compartments in which lamps of various sizes may be installed. The density of the glass panels may be varied if desired. Where walls are to be illuminated, the compartment facing the wall may supply much more light than the other compartments.

section, was a satisfactory form from both the decorative and utilitarian viewpoints.

A simple modification of this idea is illustrated in Fig. 129. The direct and indirect components are obtained as indicated by the reflectors. The remainder of the lantern is divided into four parts, as shown by metal partitions finished in white enamel. These vertical partitions join with the corners of pyramidal shells in which the direct and indirect reflectors are housed. As in Fig. 128, the panels facing the walls would be of pebbled, ribbed, or sand-blasted crystal glass, the remaining panels being of denser diffusing glass if desired. A high-wattage lamp would be installed in the compartment nearest the wall and smaller lamps in the other components. The latter lamps would be just powerful enough to render the panels not facing the walls satisfactorily luminous. If two walls are to be illuminated by a lantern near the corner of the room, two compartments would contain the more powerful light sources. This lantern has the advantage of simplicity; furthermore, the same kind of glass could be used in all the panels. In a room between 20 and 30 feet square four lanterns would be used. Their actual locations would be determined by the dimensions of the room, the height of the ceiling, and the area of the wall to be illuminated.

A lantern designed along the lines of Figs. 128 and 129 has many applications.

CHAPTER XVIII

PORTABLE LAMPS

Many of the problems of modern lighting can be solved by means of so-called portable lamps. As decorative elements in the residence and in many other places, they are often superior to so-called lighting fixtures. The latter are often ornaments out of place, but the portable lamp resting on the floor, mantle shelf, buffet, library table, and elsewhere usually strikes one as being a very logical decorative element. From a strictly utilitarian viewpoint, portable lamps compete very successfully with so-called lighting fixtures which are fastened to the wall or ceiling. Often they are much superior in usefulness, because intense illumination may be confined to the areas desired, as, for example, for reading. Their mobility permits a flexibility in the arrangement of furniture and makes it unnecessary for an architect, decorator, or lighting specialist to attempt the impossible task of locating fixtures where they will always be satisfactory. The more flexibility which we are able to permit the more satisfactory will be the furnishing and the lighting of homes and similar interiors. For this reason there should be a general tendency toward supplying an adequate number of convenience outlets and toward wiring certain articles of furniture and supplying them with proper lighting equipment. A final advantage of portable lighting equipment is that it may accompany the owner from one place to another. This is not only true of the householder, but of others as well.

Unfortunately, the portable lamp is too generally considered only from a decorative viewpoint and to be merely a shade on a pedestal. It is quite obvious that most portables are not designed and purchased for their lighting effect. This is proved not only by the many impracticable shapes of shades, but also by the fact that many cold colors are employed in the shades, notwithstanding the undesirability of these cold colors in the artificial lighting of interiors where decorative portables are suitable. Furthermore, it is obvious that few persons realize that the same scientific principles of lighting can apply to equipment which is supported on a pedestal as well as to equipment which is suspended from the ceiling. A shade on a pedestal can conceal just as much lighting equipment as when it hangs suspended. It is not the intention here to discuss the design and use of portables in great detail, for this has been done elsewhere.[1] However, some of the chief principles are discussed briefly.

The materials of a shade should be sufficient to diffuse the light properly. Too often silk shades are not dense enough to qualify in this respect. By combining two or more layers, a warm color, when lighted, can usually be obtained for any desired exterior color. Shades should have inner linings which are nearly white. They are more efficient and the effect is less harsh.

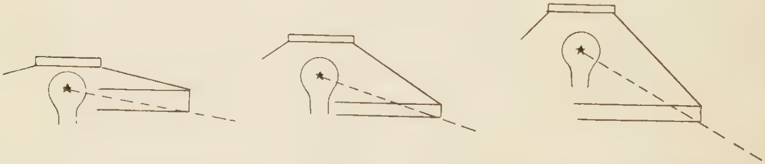

Fig. 130.—Illustrating the solid angle of direct light emitted by shallow, medium, and deep shades.

Many shades are so shallow that they do not conceal the light sources from the eyes. Others are so deep and narrow that the direct light is limited to a very small area. In most applications of portable lamps the direct light is of primary importance and this should illuminate an area sufficiently large so that a person may utilize it for reading. The desirability of a shade in supplying useful direct light is a function of the radius of the lower aperture and the height of the light source above this aperture, as illustrated in Fig. 130. A medium depth, where a line drawn from the light source through the edge of the lower aperture makes an angle in the neighborhood of 40 to 50 degrees with the horizontal, is generally satisfactory. When there is more than one light source, each should be considered as in Fig. 130. The designer should study his designs by drawing these limiting "lines of light" on the profile sketch which is drawn to scale. The purchaser should test this point by sitting near the portable, as if he were using it. The salesmen interested in selling proper lighting will make this suggestion to the customer.

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[1] Luckiesh, M., "Portable Lamps, Their Design and Use," E. P. Dutton & Company, 1924.

The shade having an entirely closed top is too generally used. For example, in the living room of the home where portable lamps supply the entire lighting, some open-top shades should be used. These permit light to escape upward, with a pleasing result. Otherwise, the room is likely to be too "contrasty." The areas of direct lighting in the vicinity of portables are charming, inviting spots, but if the remainder of the room is not sufficiently illuminated, as is often the case with dense, closed-top shades, the effect is likely to be trying to the eyes. The indirect component may be studied in a manner similar to that shown in Fig. 130 for the direct component. Usually, the top of a shade is sufficiently above the eye level so as to present no difficulties, such as exposing the light sources to the eyes.

Such simple details are very important in all portable lamps. The proof of this is evident to anyone who will appraise portables from this viewpoint. The results of neglecting these simple factors are evident on every hand.

It seems strange that there have not been more applications of the direct-indirect portable. It is easy to conceal a reflector inside a shade, as illustrated in Fig. 131. By means of a light source in this silvered-glass reflector a powerful upward component of light may be obtained. When a flood of light is not desired, the other light sources may be used. This portable now provides the same lighting effect as the ordinary one does. At the bottom of this opaque reflector is a portion of diffusing glass. Through this portion some light is transmitted, so that the shade is illuminated when only the light source supplying the indirect component is operating.

Figure 132 illustrates a portable lamp equipped with a diffusing-glass shade. Additional sockets may be installed so that direct lighting may be obtained, as from ordinary portables, independent of the light source which supplies the indirect component. The diffusing-glass shade transmits light which illuminates the silk shade, and also has the advantage of being a large source of light of low brightness, an ideal condition for obtaining direct light for reading.

These are the simplest uses of reflectors in portable lamps for the purpose of obtaining powerful indirect components of light. A great many variations of this idea are possible. Prismatic glass may be used to advantage and much more complex lighting equipment may be concealed behind the shades than is shown in Figs. 131 and 132.

The direct-indirect portable has many applications. It serves very well in the home to supply general illumination as well as direct lighting. It is often a practicable solution for the lighting of club rooms, restaurants, shops, and many other places.

The height of portable lamps is also of much importance. Although proper height depends somewhat upon the dimensions of the shade, it depends chiefly upon the use for which the portable is intended. Figure 133 illustrates the approximate proper heights of various portables. The direct-indirect portable should be tall enough so that the powerful light source in the inner reflector cannot be readily seen by a person standing. The portables used on a dressing table, at which a person is seated, may be quite low, but for a dresser at which a person stands they should

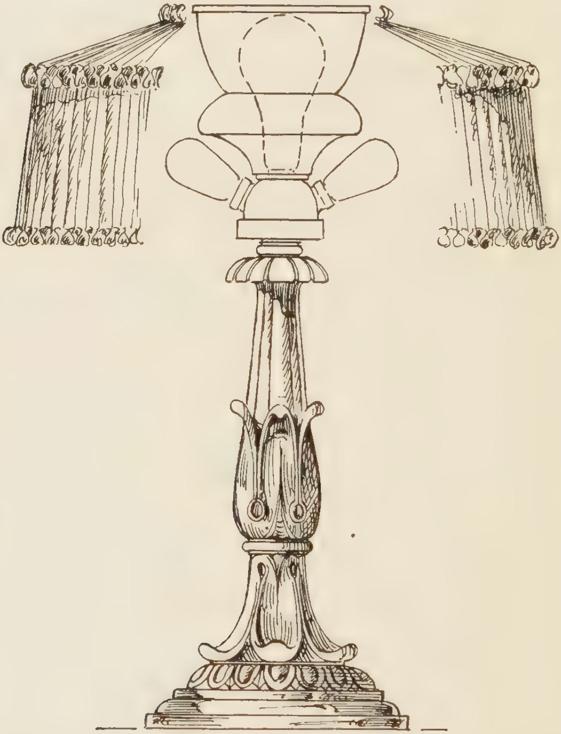

FIG. 131.—A portable lamp supplying a powerful indirect component, as well as the usual direct component.

be quite tall. The illustration is self-explanatory, for the various kinds of portables are readily recognized.

A study of the possibilities of portable lamps reveals many general and unique applications. Even urns, vases, and other objects supply places for concealing light sources, and these are portable. Ornamental troughs and sculptured articles containing light sources may be placed upon book cases and elsewhere for illuminating pictures or for supplying general illumination.

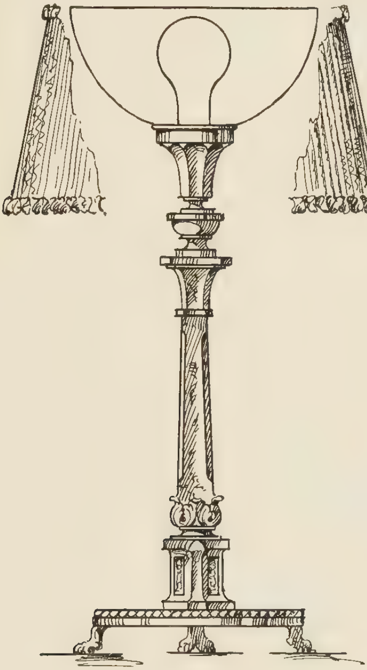

Fig. 132.—A portable lamp containing a diffusing glass bowl, so that most of the light is emitted upward.

Many applications of portable lamps may be made strictly for decorative purposes. These are ornaments vitalized by light and they have fully as much right to exist as any other purely decorative objects. Although the portable lamp is already quite popular, it is destined to enjoy a much more extensive use in a great variety of applications, from those primarily utilitarian to those purely decorative. Small portables on the buffet, on the mantle shelf, on the piano, near the beds, and in many other places add much charm to a home.

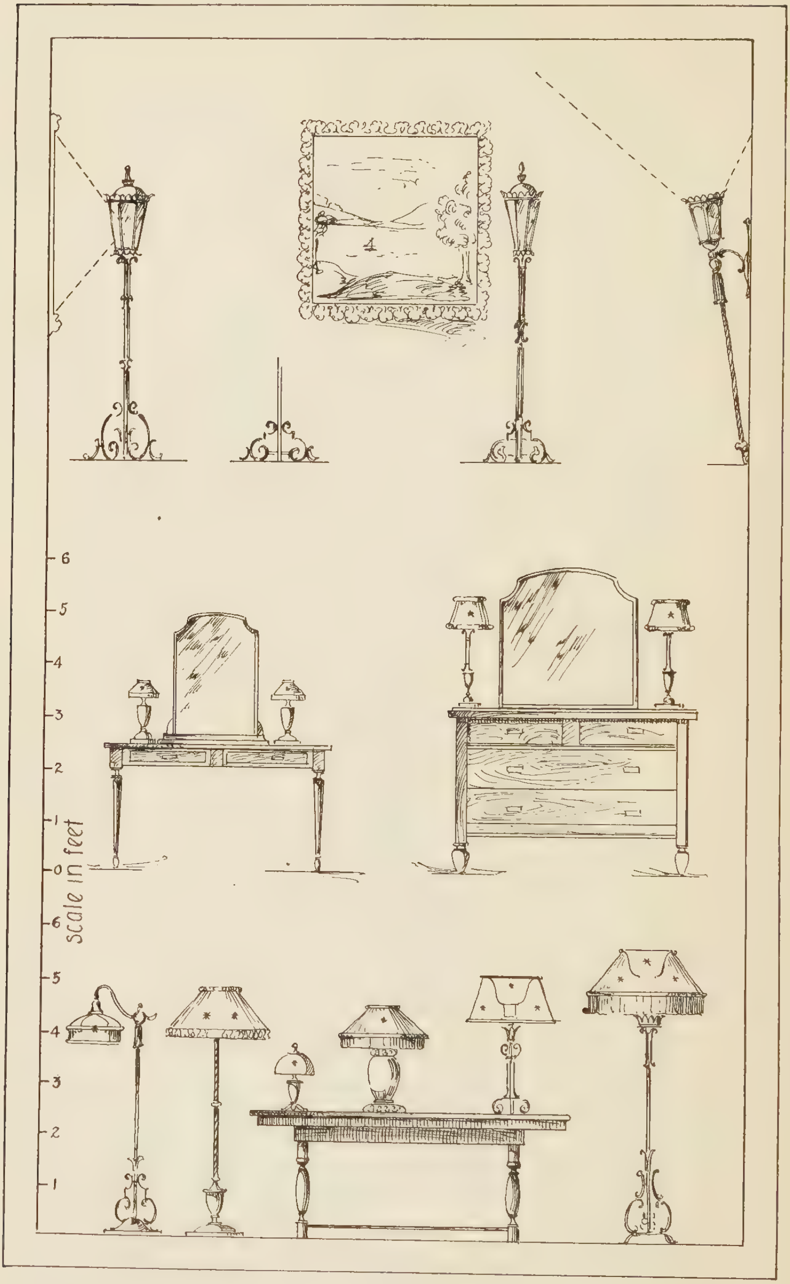

Fig. 133.—Portable lamps.

Portable lamps often provide simple and practicable solutions of lighting problems with which they are not commonly associated. For example, an important picture on the wall may not receive enough light in the general lighting of the interior. An open-top portable underneath the picture or a taller one at each side may provide the desired illumination (see Fig. 133). It is often easy to locate these portables on tables or elsewhere in such natural positions that the specific lighting of the picture is not obvious. A more formal but very effective lighting of a picture or other object may be achieved by pedestal lanterns. The panels may be dense on the sides toward the observer and quite transparent on the sides toward the picture.

A group of electric candles on a pedestal may be utilized for such purposes by using a shield which extends one-half or two-thirds around the lamps. Such portable lamps which provide much more light from one side than from the other may be used for illuminating a temporary stage for a recital or for any purpose where the result must be obtained inconspicuously. Many such applications are to be found for pedestal lamps in the home, ballroom, hotel, club, and other places.

WIRED FURNITURE

When we consider the great progress made in the manufacture of artistic furniture and the general availability of period furniture we are led to hope and even to expect that wired furniture will come into general use. One of the most satisfactory ways of providing lighting for persons using mirrors is to have lighting fixtures fastened to the mirrors. These are portables in an extended sense. In fact, the article of furniture is portable and it may be connected to a convenience outlet, just as a portable lamp is. Certainly, the lighting fixtures should be of the same period style as the furniture. The manufacturer of furniture is in the best position to provide the fixtures. Certainly, they are as important as any other detail. Lighting fixtures are now often fastened to hotel furniture, such as dressing tables and beds, and the idea should be extended to residential furniture. Other articles of furniture, such as the buffet and the serving table, could be wired so that small torchères or electric candles could be conveniently connected.

The best lighting is provided at a mirror by one light source on each side. These should be properly shaded. One or two shaded light sources at the top of the mirror provide fairly satisfactory illumination. The person using the mirror should be illuminated without suffering the annoyance of glare. No new lighting principles are involved in the design of such fixtures, but simple fixtures which are mechanically sound and easily attached are very much needed for mirrors, beds, etc. Some of these applications are illustrated in Fig. 134.

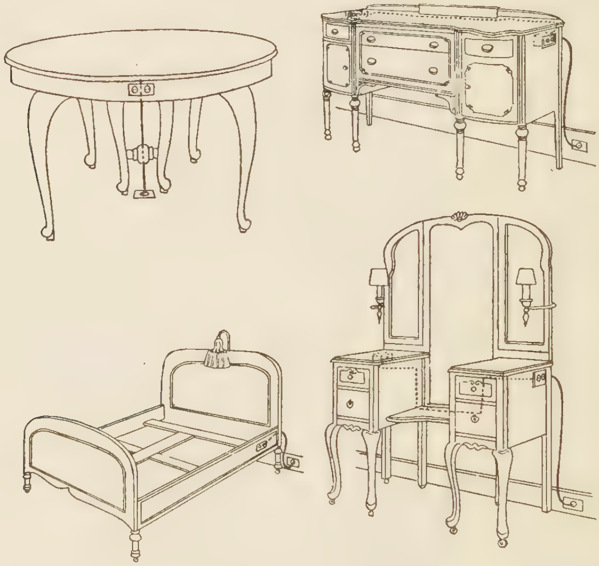

Fig. 134.—Wired furniture.

CHAPTER XIX

INDIRECT LIGHTING

As stated in Chap. VII, the classification of lighting systems is not entirely satisfactory. However, indirect-lighting is generally understood to mean a system from which most of the light reaches the lower level of the interior after reflection from large areas such as the ceiling. Of course, the ceiling itself in such a case receives light directly from the light sources or fixtures. The illumination is indirect if we consider the lighting of the floor, for example. However, we are now learning that the lighting effect on the details and areas of an interior is one of the important phases of modern lighting. The mood or expression of an interior is not determined solely by the architectural ornamentation, relations of areas, and the decorative scheme of paint and other wall coverings. The relative amounts of light which the various areas receive, the distribution of light on various objects, and the color of the light have great influence and are often overwhelming factors in the production of the desired mood.

Indirect-lighting corresponds to the lighting effect from the sky outdoors. It has a very important place in interior lighting, for there is scarcely an interior which should not have an appreciable indirect component. Some interiors may be satisfactorily illuminated by indirect-lighting, for example, auditoriums and certain "architectural" interiors. Most interiors require a combination of direct and indirect lighting. A restaurant or a ballroom, for example, may have a predominant indirect component, but some direct lighting (that is, some luminous sources) is desirable to provide the desired depth of shadows and to vitalize jewels, gowns, and other finery.

Indirect lighting is usually obtained from so-called fixtures, but where the architect fully cooperates very interesting and effective lighting effects may be obtained from lighting equipment concealed behind architectural details. The indirect lighting fixture usually consists of silvered-glass reflectors concealed in an ornamental housing. Great refinement of light control is possible with such equipment. Such a fixture is usually quite dark as compared with the ceiling. The lighting effect often possesses the fascination of mystery. Sometimes the dark fixture is unsatisfying because, naturally, we expect to see it luminous. To satisfy the demand of this association, the fixture may be made self-luminous by means of auxiliary light sources behind the glass bowl or panels, as illustrated in Fig. 135. The desire or expectation is now realized and the lighting is still practically totally indirect. This luminous fixture for indirect lighting may be tinted so as to give the feeling of warmth of color without altering the color of the indirect component.

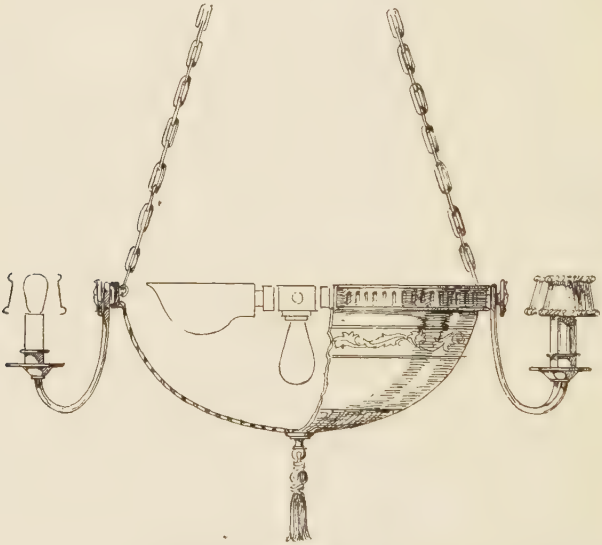

Fig. 135.—An indirect-lighting fixture having a luminous bowl.

Most persons appraise the lighting of a room entirely, or at least largely, by looking at the fixtures. Therefore, the brightness and the color of the luminous part of fixtures have a great deal to do with the conclusion which persons formulate. Knowing this to be a fact, it is legitimate to utilize these powers. For example, if the bowl illustrated in Fig. 135 is illuminated by the warm light from flame-tinted lamps, most persons will feel that the light in general is quite warm in tint, even though 90 per cent of the light reaches them indirectly from ordinary tungsten lamps. Of course, light is altered in color by diffuse reflection from colored surfaces, so that in indirect lighting the color of the ceiling and walls should be taken into consideration. A very dark color, such as deep-blue or deep-red, will alter the color of the light considerably, but since it has such a low reflection factor its effect will not be as noticeable as that of an equal area of canary yellow in the same room. In other words, not only the color of a surface but also its reflection factor must be taken into account in appraising its effect in coloring the light by reflection.

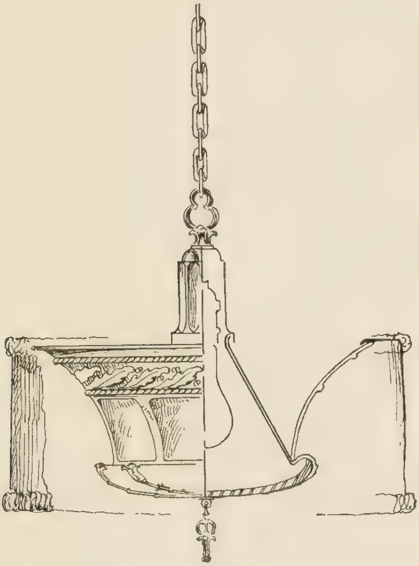

FIG. 136.—A fixture providing a dominant indirect component. The percentage of direct light obtained depends upon the density of the glass plate at the bottom.

In Figure 135 the electric candles were added because multiple light sources seem to be necessary in many cases to produce the most pleasing appearance of a fixture. A large area of low brightness, such as the bowl, is not always satisfying. These multiple light sources could be pendent shades or even frosted lamps without shades in a large room with light surroundings.

Figure 136 illustrates a fixture which is designed to provide a predominant indirect component of light with various percentages of direct light, depending upon the density of the glass plate beneath the lower aperture of the opaque reflector. From the top rim of the metal reflector a shade of parchment or of textile may be suspended. With a plate of light-density opal glass or of frosted crystal glass a prominent direct component of light may be obtained, although the indirect component will always be dominant. With a very dense plate of diffusing glass, this portion of the fixture may be barely luminous. This idea is subject to many variations and has many excellent applications.

One of the most pleasing effects which the author has seen is obtained by means of plate glass into which light is admitted through the edges in the manner utilized in certain signs in hotels and elsewhere. A simple application is illustrated in Fig. 137. The device is really an indirect-lighting fixture, but beneath the opaque bottom is a plate glass. The latter receives light through its edges from the central lamp and the colored etchings upon it are vitalized with light. It is one of the best examples of utilizing some of the latent powers of light as a medium of expression. This description does not do justice to the lively beauty of this glass. The remaining portions of the fixture, including the bottom above the plate glass, are opaque and the other lamps supply the primary lighting effect. There are many applications of the idea shown in a very simple form in Fig. 137. Here we have one of the rare applications of light as a decorative medium which is well worth while.

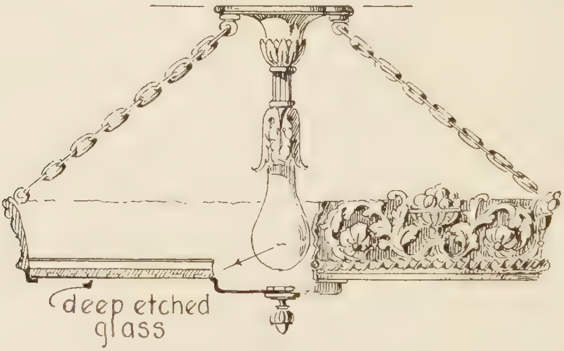

Fig. 137.—A new indirect-lighting fixture having a glass bottom with etchings illuminated by light which enters the glass through the hole in the center.

Figure 138 illustrates a combination indirect-lighting fixture with a "luminous bowl" and a direct-lighting component. Such a unit could find many applications in reading rooms, dining rooms, distinctive shops, etc. The general illumination is supplied by the indirect component emitted by the silvered glass reflectors. In the center is a lamp which illuminates the parchment, silk, or glass bowl which conceals the lighting equipment. An aperture in this bowl permits direct light to emerge as indicated. This direct component could be used for various purposes, such as reading, dining, or the display of goods on a table beneath.

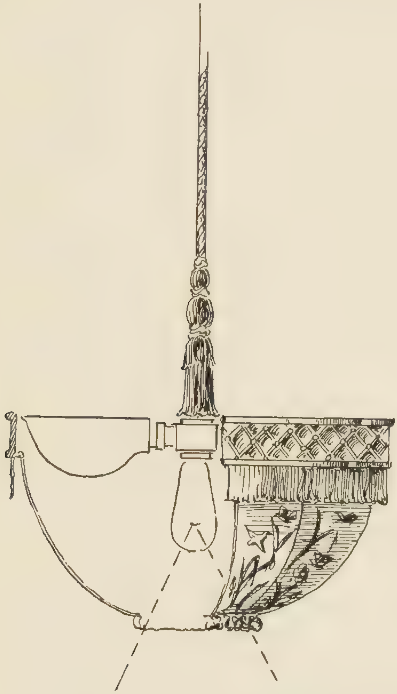

Fig. 138.—A fixture supplying an indirect component and also a direct component.

The foregoing illustrates only a few possibilities throughout a great range of them. When one thinks of the design of fixtures from the viewpoint of lighting effects and not merely in terms of lamps and sockets, countless designs occur to him, each of which will solve a specific lighting problem in the best, or, at least, in a very acceptable, manner. Pedestal fixtures are readily applicable to indirect lighting. They may be surmounted by opaque or translucent bowls in which modern lighting equipment is concealed. Figure 139 illustrates such a pedestal bowl containing silvered glass reflectors. The bowl may have portions consisting of diffusing glass and these may be rendered self-luminous as illustrated in Fig. 135.

Urns, vases, and similar receptacles may also be utilized for indirect lighting. Such devices are particularly applicable to interiors of period styles from which we have inherited no lighting fixtures adaptable to modern lighting. For example, a large interior of classic spirit might be illuminated, partially at least, by indirect components emitted by urns or vases reproduced from prototypes of the period. Certainly, the Greeks and Romans would have utilized modern lighting in various ways if they had had it available. We have no patience with those who will not

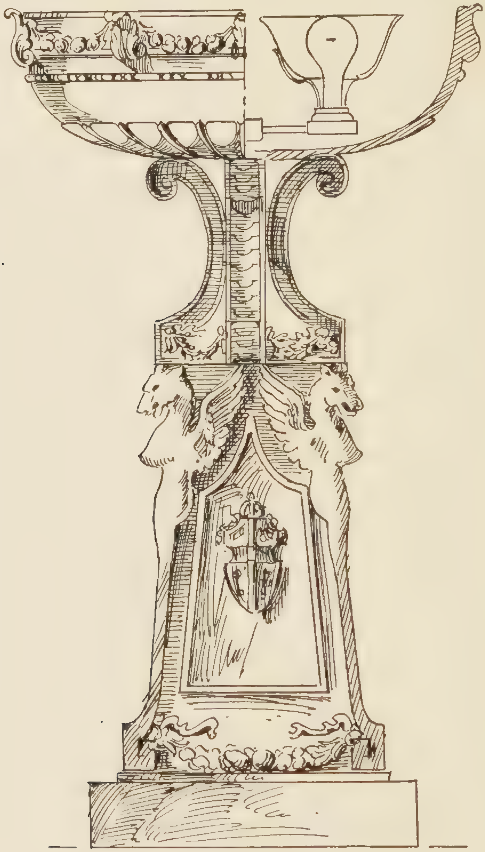

FIG. 139.—A pedestal bowl.

move forward by adapting the new to the old or the old to the new. Some of these ideas are suggested in Figs. 133 and 140.

Indirect lighting as obtained from light sources concealed in the architectural details is one of the most fascinating phases of lighting. The possibilities and their combinations are numberless. Among the many places for concealing lighting equipment are carbels, capitals, cornices, moldings, panels, wall boxes, window boxes, window sills, rosettes, plaques, domes, friezes artificial windows, niches, skylights, urns, and finials.

CHAPTER XX

OTHER DECORATIVE USES OF LIGHT

In the discussion of the fundamentals of lighting fixtures the decorative element of light has been distinguished from the direct and indirect components. In other words, in analyzing lighting fixtures it has been pointed out that a certain amount of luminosity must be distributed so as to produce pleasing variety if the fixture is to be attractive in itself as a lighting fixture. This is achieved by means of multiple light sources in the case of a chandelier and by sparkling crystals of glass in some cases. A single unit, such as a lantern, may obtain this multiplicity or variety by means of several panels. In fixtures having a censer motif (Figs. 126 and 127) this variety of luminosity is produced by the metal openwork. There are many ways of introducing this decorative-light element which usually makes fixtures so much more charming than single areas of uniform luminosity. There are many other phases of this decorative aspect of light, but in order to conceive and to utilize them one must think in terms of this new medium—modern artificial light.

A beautiful exterior decorated with architectural details, such as arches, columns, cornices, and paneled ceiling, and finished in certain combinations of paints or other wall covering might just as well have been constructed centuries ago if artificial light is used only in lighting fixtures which are imitations of earlier prototypes. The only decorative medium now available to the artist which the artists of the Renaissance did not possess is modern controllable artificial light. A great opportunity now awaits the lighting artist, but the architect and the decorator may readily grasp the potentialities of this relatively new medium, as they have appreciated in past centuries the introduction of mosaic art, of stained-glass windows, of sculpture, of painting, and of other arts when these first appeared as decorative media. The same principles apply to light as a decorative medium as to paint, for example, except that light has greater powers and a monopoly on mobility of effects. Some of these phases are discussed in earlier chapters.

The possibilities of artificial light as a decorative medium may be illustrated by an extreme case. Let us assume a large interior finished in grays, but adequately equipped with electric wiring laid out according to the various areas and ornamental details. In other words, various panels in the ceilings, archways, the frieze, the central dome, and various minor areas may be illuminated by light confined to each respectively. Over the whole a flood of light may be obtained from pedestal fixtures. We may further assume artificial windows, lattice work, ceiling skylights, self-luminous panels, and grill work backed by illuminated surfaces. With proper control and a sufficient paralleling of circuits, it is obvious that the various surfaces may be painted with light. They may be of any desired brightness and color. Owing to the mobility of light, this effect may be changed very suddenly to another one or modulated as slowly as desired. In other words, we have substituted for a fixed color scheme a mobile decorative scheme of much greater potentiality.

Contrast is one of the most powerful tools of the artist, and in lighting we have a means of extending the range of contrast far beyond that of pigments. For example, a dome may be highly illuminated by means of light sources in a cornice beneath it, thereby being set as far apart from the scale of the remainder of the interior as desired. No sky-blue paint alone on the interior of a dome can come as near producing an illusion of the sky as this lighting effect from concealed sources. There is also a definite and accurate confinement of the high brightness to the area desired. Furthermore, by concealing light sources behind moldings and other architectural details there is an interesting symmetry of effect and a uniformity in direction of shadow for any particular architectural detail which is very desirable in certain interiors. Of course, there are many interiors, such as a living room in the home, where symmetry of shadow is not desirable, but in certain pretentious interiors where architectural details are pronounced and naturally are symmetrical, it is desirable to lead the light along certain lines and to confine it primarily to certain areas.

In some cases space will permit the use of sockets and electric lamps only, but usually the architect will find it possible to make room for the use of efficient reflectors, as illustrated in Fig. 140. Certain reflectors are designed to project the light to a distance without permitting much light to escape directly to the area near the concealed light source. This arrangement eliminates the bright spots so common when lamps with or without ordinary reflectors are used. In some cases such spots are desirable. For example, lamps concealed in capitals may produce brilliant spots above the capital which fade away upward. Such an effect in a certain church is beautiful, because above each capital the bright spots fading quickly away above it suggests flames. It is out of the question to illustrate all the possible effects. In fact, they will occur to the architect and to others who think in

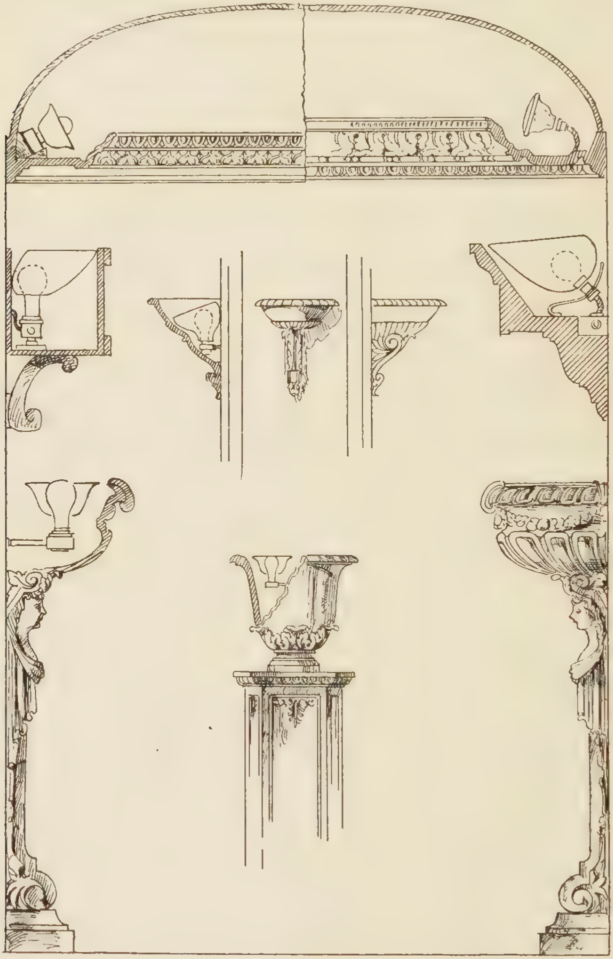

Fig. 140.—Lighting equipment concealed in architectural details.

terms of painting with light. However, a few of the possibilities are mentioned herewith.

The corbel might be introduced purely as a decorative element and a light source concealed within it may provide an indirect component of light as well as a decorative brightness adjacent to it.

The capital is sometimes an ideal place of concealment for light sources and the lighting from it may primarily be either useful or decorative or both.

A frieze may be illuminated by light sources concealed in a cove beneath it or above a molding on the ceiling a few feet away from the wall. A scenic frieze may be illuminated independently and to good advantage.

A cornice may conceal a single row of light sources, or it may be elaborate enough to contain more than one row at different levels. Panels in ceilings, if elevated sufficiently above their surroundings or bordered by deep moldings, may be illuminated to various intensities of illumination as desired.

A dome may be made as bright as desired without any effect on other areas, except that the light reflected from it may reach the floor level and be utilized there.

Skylights, wall plaques, and small transparencies in the ceiling and elsewhere are decorative elements of light which may be as brilliant, sparkling, colorful, or subdued as the architect or decorator desires. These may be jewels of light.

Rosettes in the ceiling may conceal light sources behind them or they may contain exposed light sources and perform the function of jewels of light. The latter use should be practiced sparingly, however, and only in large interiors with fairly light ceilings.

Wall boxes, window boxes, or their equivalents may be introduced purposely for concealing light sources for utilitarian indirect lighting or purely for decorative lighting.

Niches may be provided primarily as light elements. Sculpture may be silhouetted against its bright background or the sculpture may be set far enough into it to receive light from sources concealed within its edges or in its overhanging canopy. In this case a dark background is particularly effective. A similar recess may be illuminated to supply a background for a grill or a stained-glass window.

Artificial windows with scenic backgrounds or purely providing illusions of daylight or moonlight are interesting possibilities.

The tint of the light may be varied to suggest daylight, sunset, or moonlight. Skylights may be utilized for this purpose with pleasing results.

Bowls on pedestals, urns, and vases may consist of alabaster or dense decorative glass. Such self-luminous objects of low brightness are vitalized ornaments which have their place in decorative lighting.

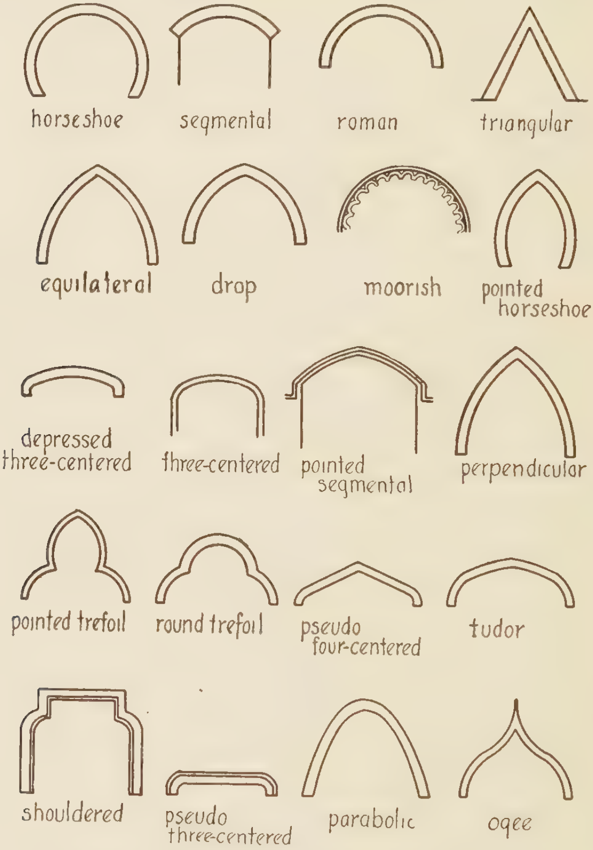

Fig. 141.—Representative arches of various periods.

In approaching a problem of introducing interest and variety into an interior by means of light, it simplifies matters to separate distribution of light from color of light. One may first decide upon a number of distributions of light and brightness which are compatible. Then these may be combined as desired and, finally, color may be introduced by means of accessories, as discussed in early chapters.

One of the most distinguishing characteristics of period style in architecture is the arch and, therefore, the most important types of the arch are presented in Fig. 141. These may be helpful, in connection with some of the illustrations in earlier chapters, to those unfamiliar with architectural details. The arch is a useful motif in the design of lighting fixtures and other lighting accessories.

ARTIFICIAL WINDOWS

Painted-glass windows rank high among the treasured and admired jewels of art, but, alas, the splendor of painted glass had been eclipsed for two centuries. This art began at least as far back as the tenth century and reached its full development in the twelfth century. For five hundred years it was much in favor and it provided the marvelous jewels of light for the great cathedrals. Painted windows are gorgeous elements of decoration. They possess a vitality superior to any other art object, except perhaps brilliant cut jewels. They exemplify the powers of light because they are primary lights. The range of contrasts and the depths and purity of colors are those of primary light. A comparison of a painted window seen against a bright sky with a painting of the window done in pigments emphasizes the potentiality of primary light. Why the art of stained glass was eclipsed is a question which, perhaps, does not have a simple answer. Nevertheless, such a gorgeous adjunct to decoration should not be unused.

Habit accounts for a good deal of inconsistency in life. The stained-glass window developed in an age when men loved beauty to such an extent that they devoted their lives to its production regardless of their own material profit. The present swiftly moving age is one in which science has eclipsed art or at least is a formidable rival. But may not science aid art sufficiently to offset the effect of dividing the attention of civilization between it and creative art? Certainly, it is doing much for art in many directions. Science gave to us marvelous possibilities of modern artificial light. It has made the products of art attractive at night. It has extended the day of art beyond sunset to any extent we desire. Why should it not provide backgrounds against which painted windows may be seen regardless of daylight? Painted windows were made to be seen in the daytime, preferably against the sky. Are we to be slaves of habit and precedent and refuse to illuminate painted windows with artificial light?

A painted window which may be seen only when sufficient daylight is available may have difficulty in justifying this existence. In churches, for example, it may be appreciated only during a single morning service each week. Ordinarily, there is more than one evening event each week in a church. Can the painted windows justify their existence on this basis? But such splendid decorative elements should have a wider application than merely in the church. We have paintings on the walls of our homes, offices, and many other interiors. Why should we not utilize the painted windows more generally? The author believes we would if artificially illuminated backgrounds were provided. The theater and many other interiors are richly decorated with paintings, sculpture, carvings, and furnishings. What more charming effect could be produced than that of groups of painted windows in interiors suitable for them? Even the beautiful theaters and auditoriums of the present time would be even more splendid if they had painted windows with artificially illuminated backgrounds. Their backgrounds could be dimly illuminated when the auditorium is darkened and besides being a charming decorative element the illumination which they provide would be useful. When the auditorium is brilliantly illuminated they could be likewise.

It is not difficult to provide an illuminated background for a painted window, as is seen in Fig. 142. A white plastered recess can be provided a foot or two in depth, depending on the width of the window. A satisfactory cross-section of this is shown to scale. Electric lamps may be installed as shown, so that these, although invisible through the window, illuminate the recess. The window is seen against this white background. Reflectors may be provided for the lamps so that the recess is fairly evenly illuminated.

For a very small window, where only a few inches of depth are obtainable, a diffusing glass behind the window may be illuminated directly by means of tubular lamps properly spaced. Such a simple solution is illustrated in Fig. 143. In this case care should be exercised in avoiding too great non-uniformity, although the character of a painted glass does not demand perfect uniformity of brightness of background. The illuminated recess is the best solution and it is easy to provide such recesses in the original structural plans. We are neglecting one of the most fascinating elements of decoration perhaps because of the habit of depending upon natural light (see Fig. 150).

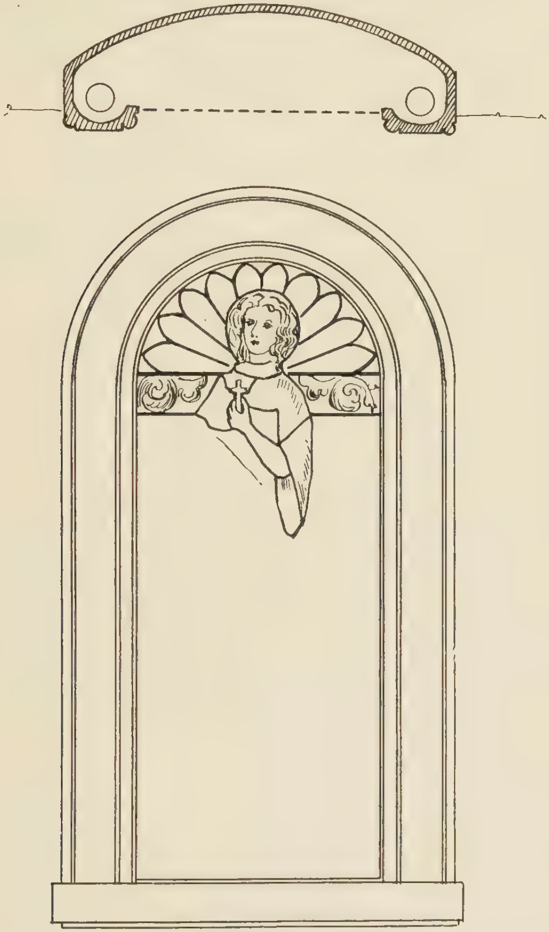

Fig. 142.—Providing an illuminated background for a painted window.

In our congested cities, outside walls are not always available where desired. Sometimes the architect may find it desirable to introduce artificial windows either to balance actual windows or to provide the psychological effect of natural illumination where actual windows cannot be had at all. These artificial windows need not be glazed or they may be glazed with obscuring or with clear glass. In the latter case a mural painting or even a scenic panorama might provide a finishing touch. Such a solution was successfully utilized in a certain elaborate building. Various experiences with artificial windows in underground passages, basement restaurants, and elsewhere have convinced the author of the decorative value of artificial windows and of their pleasing psychological effect. When obscuring glass is used, the light sources may be installed only at the upper part of the window to create the desired illusion. Ordinarily, only the upper part of the window has a bright background of sky.

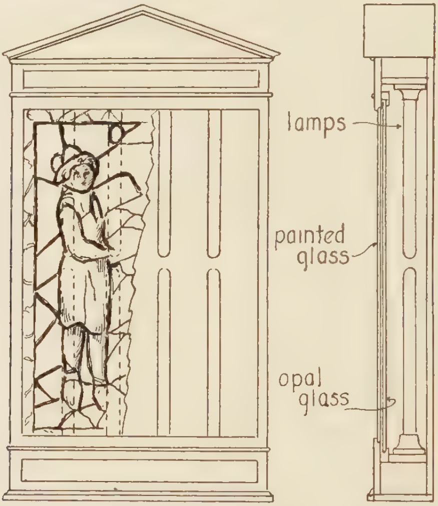

Fig. 143.—Illustrating how a small painted window may be artificially illuminated in an interior.

In artificial windows glazed with clear glass a lattice outside the window and covered with vines is quite satisfactory. The background may then be painted a sky-blue or even with appropriate scenery. The lattice and foliage break up the background sufficiently so that its artificiality is not obtrusive. An artificial window is illustrated in Fig. 144. Lamps of greater wattage are used at the top than at the bottom. In fact, the lower lamps are not needed in some cases and not at all if the background is painted somewhat darker at the top than toward the bottom in order to compensate for the much greater intensity of illumination at the top than elsewhere. Various simple expedients may be resorted to in order to reduce the non-uniformity of illumination of the background.

In order to provide the illusion of spaciousness and outdoors as well as being decorative, a lattice may be used successfully in the upper half of the wall or even as a frieze. If a depth of a foot or so is available behind this lattice, concealed lamps can be installed for illuminating a painted background. There are many interesting applications of this general idea.

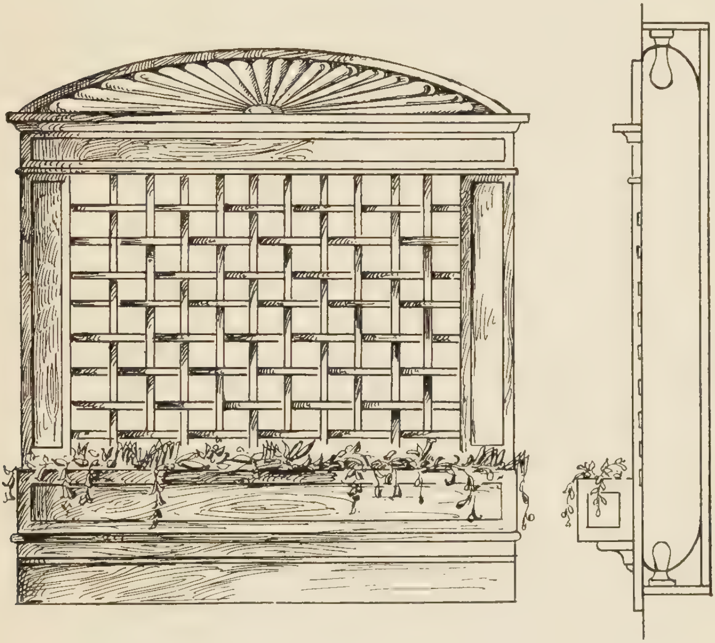

Fig. 144.—An artificial window.

Painted windows installed in churches and elsewhere in the usual manner, for viewing by daylight, have been successfully illuminated by artificial light. When such windows are installed in light courts, it is an easy matter to illuminate the opposite side of the court to provide a background against which the painted windows are to be viewed. When such a background is not available, reflectors may be used to flood the windows with light from the exterior.

ARTIFICIAL SKYLIGHTS

Translucent ceilings for the admission of artificial light are not uncommon, but it is no more logical to provide artificial skylights than artificial windows. If the glass is perfectly diffusing, the lighting effect is quite like that of indirect lighting, provided the entire ceiling is glazed with the glass. Directedness becomes more and more apparent as the area of the skylight decreases. If light is to be controlled by means of reflectors above the skylight, the glass need not be clear, but, if it is any more diffusing than frosted, pebbled, or ribbed crystal glass, control of light is lost. In other words, if light is desired on the walls, as in a paintings' gallery, light may be projected through the slightly diffusing glasses mentioned above.

Translucent ceilings are useful in obtaining effects with colored lights. The latter may be mixed in the desired proportions above the glass and the entire glass may appear of the resultant color. This is an excellent means of obtaining secondary lighting. For example, in a certain residence a beautiful oval skylight is located in the ceiling of the dining room. Red, green, and blue lights are mixed by controlling the lamps by means of dimmers in a wall panel. Thus, moonlight, sunlight, sky light, and many other tints of light are obtainable as secondary lighting supplementary to the light of electric candles on the table.

A decorative skylight may be laid out in sections and light of different tints may be confined to these respective sections as desired. The architect, in designing a skylight or decorative ceiling, works in form and color. If he takes artificial light into consideration, he may design a number of color schemes, each of which, with the aid of a number of electric circuits, dimmers, and colored accessories, he may use when he wishes to. This is one of the interesting ways of introducing variety into an interior. The necessary information and equipment are available to anyone who will search for them.

Some interesting effects are produced with openwork or grilles in the ceilings. The background, which should be sufficiently above the grill, may be illuminated to any intensity with any color of light desired.

LUMINOUS PANELS

These miniature skylights in the ceilings or walls are effective decorative elements and also provide useful light to some extent.

They are particularly useful in corridors and in theaters. Countless patterns are possible and they may vary from sparkling jewels to softly glowing areas. By introducing colored light, the variety of effects is further increased.

A simple installation of such a panel is illustrated in Fig. 145. The colored-glass accessory is shown as it may be installed in a white enameled box. A good combination in the motion-picture theater is deep-blue and warm-yellow, the former being in use when the picture is being shown. Various kinds of colored-glass accessories are available for such purposes, as indicated in Fig.

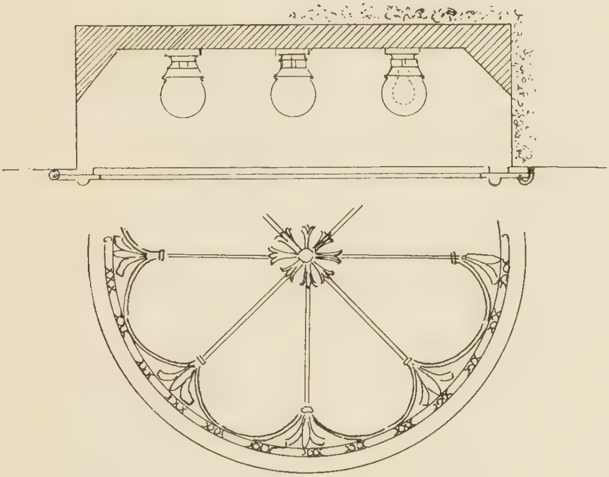

FIG. 145.—A luminous panel in which the light sources and color caps are installed.

14. They have the great advantage of permanency in color over the fugitive colors of most superficial colorings for lamps.

If a small grille is desired flush with the ceiling, one of the simplest means of illuminating its background is to use a box something like that shown in Fig. 145. A diffusing glass may be installed just above the grille.

A disadvantage of a panel flush with the ceiling is the lack of illumination on the areas of the ceiling adjacent to it. Sometimes this is just the effect desired, but, when it is not, the simplest solution is to drop the panel somewhat below the ceiling. Its sides must be translucent and they should extend below the ceiling a few inches, depending upon the appearance.

An interesting effect may be obtained by inserting a spotlight in the ceiling as suggested in Fig. 146. The opening may be covered with a colored glass, or a clear or frosted one. Such a device has utilitarian value in illuminating small areas, an usher, an entrance to an aisle, and other things without permitting light to be scattered elsewhere. A number of these spotlights located in the ceiling of a dance hall, for example, provide interesting variety. The dancers moving in and out of the beams of various tints produce an effect of mobile light. The spotlight illustrated in Fig. 146 could readily be made adjustable, so that it could be directed toward an object on or near the wall. In this manner various high lights may be obtained in an interior or art objects could be illuminated purely from a utilitarian viewpoint.

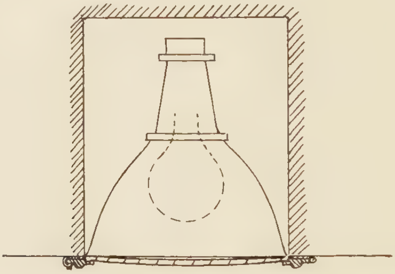

Fig. 146.—A spotlight set flush with the ceiling.

A simple compromise between the wall plaque and the wall fixture is a large shield placed before one or more electric lamps. With the proper frame, such a device is very effective and, obviously, very simply constructed.

There are many variations and applications of these ideas.

NICHES

Another interesting element in lighting and decoration is the niche or small alcove. This niche may be merely an area of light—a high light in the interior. It may contain a sculpture, a vase, a painting, or any other interesting object. If it is to be an effective decorative element of light, provision must be made to install light sources and, in the larger niches, reflectors. The principle of lighting is quite similar to that illustrated in Fig. 142. However, with an opening instead of a window, provision should be made to screen the light sources from view.

In Fig. 147 the lighting principles which are involved are illustrated in a simple manner. The light sources are screened effectively from view by the return without interfering unduly with the direct illumination of the object in the niche. The light sources may be placed only in the upper half of the niche and entirely down the sides if desired. The direction of predominant light may be obtained as seems best by placing a high-wattage lamp in the proper positions. The other lamps may be of much lower wattage so that they perform the function of softly illuminating the shadows. If a spectacular touch is desired, a very striking effect can be obtained by means of lamps of two or more colors. These colored lights coming from different directions produce very striking effects of colored shadows. Even if all the lamps are of the same color, such as red, except for one powerful lamp which emits colorless light, a very interesting effect can be obtained. The high lights on the object will be colorless, but the shadows will be of various shades of red. A black velvet background is particularly valuable for these effects. Here also will be found endless possibilities of great interest.[1]

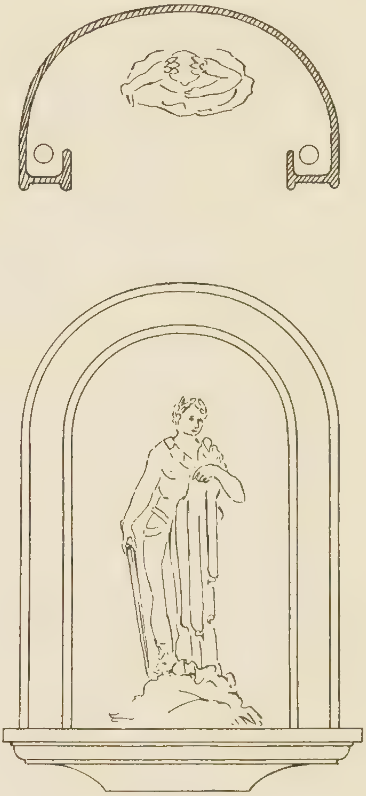

Fig. 147.—An illuminated niche for sculpture.

There are many cases where rooms have been especially built for an individual painting. In other cases, a painting is important enough to have a dominating position. Usually, the lighting is neglected until it is too late to do the best that could be done. When the architectural details are such as to afford concealment for lighting equipment in the proper position, the solution is

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[1] Luckiesh, M., "Light and Shade and Their Applications," D. Van Nostrand Company.

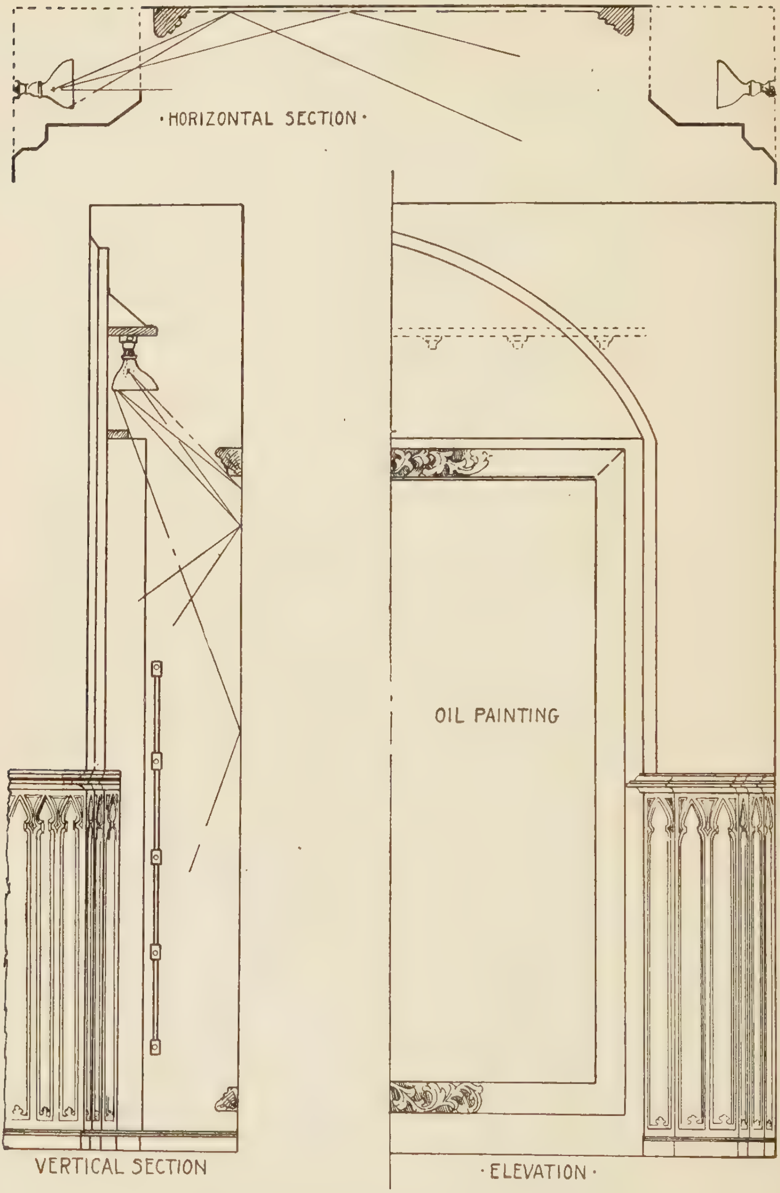

Fig. 148.—An illuminated alcove for a painting.

simple. This can be provided by means of an alcove for the painting, designed with the same principles in mind as are illustrated in Fig. 147. The architect should find it of interest in designing residences and various interiors to bear in mind some of these possibilities.

Figure 148 illustrates the solution adopted for illuminating an important painting which was already in place. The architectural details were such as to make it possible to revise them so that lighting equipment could be concealed as shown in the horizontal and vertical sections. This drawing is to scale. The dominant light is from above, but, owing to the extreme shallowness of this alcove, it is necessary to have some lighting equipment along the sides as indicated. Such lighting makes a painting stand forth in a manner becoming its importance.

FOUNTAINS

Artificial light properly used with fountains can vitalize these decorative adjuncts quite out of proportion to their cost. Unfortunately, many of the attempts have resulted in garish effects, due to exposed light sources and powerful colors. Only the very large fountain as a rule can be ornamented with exposed light sources. The most charming effects are those produced by concealed sources. Vaporproof lighting equipments are available which serve admirably for fountains. The lowest pool or basin might be rendered luminous in the manner suggested in Fig. 149. The glass cap, either clear, diffusing, or colored, screws into a receptacle which is vaporproof. The caps available are

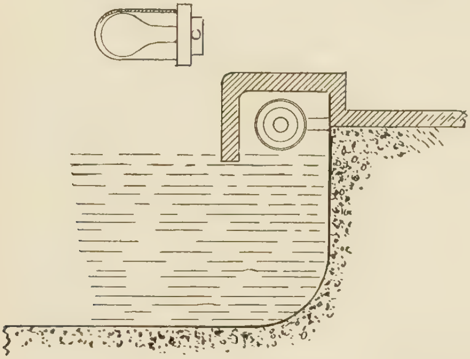

Fig. 149.—Illustrating how the basin of a fountain may be illuminated by means of light sources in color caps concealed above the water line.

illustrated in Fig. 14. The vertical shield should extend below the water level in order that the image of the light source may not be reflected into the eyes from the surface of the water. The lamps may be replaced by reaching up under this overhanging screen after the basin has been drained. Such lighting is not effective unless the bottom of the basin reflects an appreciable amount of light. Obviously, white tile or white cement which is kept clean is quite suitable. Such an arrangement of light sources eliminates the nuisance of leaks so common in fountains with luminous panels submerged in water. Even the conduit enters the structure above the water level.

Upper basins of fountains which are above the eye level do not require screening for the lamps as shown. In such cases, the conduit may be run vertically in the interior of the central shaft and the lamps may be located above the water level around the central portion. If necessary, glass covers may be installed to keep water from dripping on the lamps.

Housings containing lighting equipment and a thick glass cover may be set in the sides of a swimming pool. They not only provide useful light, but the luminous pool is attractive.

When one studies the flow of water and the illumination of jets of water, he soon realizes that here is a field which requires much study from both artistic and optical viewpoints. It is beyond the scope of this book to enter into a discussion of such matters. The primary purpose has been achieved in bringing to the reader's attention the simplest principles and, particularly, satisfactory equipment and means of illuminating basins from concealed sources.

MOBILE LIGHT, COLOR, AND PATTERN

Nature has been kind, indeed, in wearing a subdued garb, for had we been exposed for countless centuries to a highly colorful environment our senses would now be benumbed to these stimuli. As it is, now and then or here and there, Nature offers a bit of bright color, but where the areas are large, such as sky and vegetation, the colors are subdued into tints and shades. This leaves us fresh to react toward color. Mankind through scientific knowledge has produced a vast array of colored dyes and pigments and in recent years has produced efficiently the colors of greatest power—colored lights. The scientific control of modern artificial light has made it possible for us to utilize this new medium of expression. Lighting will eventually become a fine art.[1]

Not only will we utilize the powers of light in fixed artistic expressions, but we will develop the mobility of light. Even at the present time the scientist is far ahead of the lighting artist, for he has developed the means for producing effects of mobile light and even of fascinating mobile patterns. It is encouraging to find artists entering this field, but it is amusing to find them making "discoveries" with which the scientist has been acquainted for years. The lighting artist has many surprises awaiting him when he learns what the scientist, skilled in the control of light and pattern, has already achieved in the production of beautiful effects. Here we have a great opportunity for coordinating the skill of the scientist with that of the artist.

We have some knowledge of the psychophysiological effects of light, color, and pattern as discussed in early chapters. But, unfortunately, some practitioners claim knowledge which is as yet unavailable; however, the only damage which is done is confined chiefly to the purse of the unwary. While scientists are further unraveling the tangled skein, what is already known may be utilized in adding variety to the drabness of everyday life. Furthermore, it is legitimate for the artist to experiment in the full scale of interiors.

As previously stated, Nature is not highly colorful, except on rare occasions or on small areas. Therefore, colors have not been rendered powerless. The emotive value of mobile color is not so strong as that of music, but it is just as real. A little music daily is good for us, but we could not enjoy continuously a symphony concert or a Wagnerian opera. So it is with color. Exposure to colorfulness is a bit of variety whose effect is similar to that of music and this effect is not merely confined to esthetics, but has a deeper psychological influence. The artist says that it is his work to take the developments of the scientist and make a lighting art. However, the artist's realm is esthetics which does not dig deep into the psychophysiological realm. Here the scientist is found unearthing knowledge which makes him very necessary if the lighting art is to develop beyond everyday esthetics.

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[1] LUCKIESH, M. "Artificial Light and Civilization," chap. 25, The Century Company.

Most of us cannot afford colorful surroundings which must be changed often by the decorator if they are not to defeat their purpose. The decorator and the furnisher fix the color scheme. Unconsciously, we know we will tire of this fixed color scheme and so for safety we adopt plain and relatively colorless surroundings. Thus, we are deprived of the music of color, because the element of mobility has not been practicably introduced.

The possibilities of modern light sources, however, are awaiting wider application. Colored light is very much more powerful than colored pigments. It tinges everything, while a colored vase extends its influence barely beyond its boundaries. Why not have fairly neutral surroundings most of the time and then when we want colorfulness merely press the switches? From hidden sources located in fixtures, ornaments, wall boxes, and architectural details, springs forth this wonderful mobile medium. And these tinted lights also retire when we will it. In our dining rooms, theaters, public halls, etc., by calling forth these colored lights of mobility and power, we can enjoy the quiet, cooling effect of blue light, the radiant cheer of the warm tints, the stimulation of orange light, and a play of color as harmonious or as strenuous as desired. And with a pressure of switches they disappear until called forth again.

Interiors can be different nightly or momentarily. But why stop here? Why not recognize our complete control over modern artificial light? The decorator has a range in contrast from white to black—thirty to one—and his colors cannot compete in purity and power with colored lights. With light, the possible range of contrast is from the brightness of the source to the deepest shadow—a range of millions. With proper optical control the brilliance of the sparkling jewel may be produced. Luminous panels can radiate not only mobile light and color, but mobile patterns. Imagine a skylight of subtly changing patterns! This may be accomplished even now, as has been demonstrated by the author on various occasions. This mobile effect may be of subdued color and pattern, or it may be a gorgeous sparkling jewel of great brilliance, ever changing in pattern. No decorative scheme which is fixed can compare with these vitalized effects of light.

Everybody knows that music has the power to stimulate or to depress. No knowledge of music is necessary for a person to react quite differently to a grandiose martial air, a lively dance tune, a dreamy waltz, a sentimental song, or a funeral dirge. Light, color, and pattern have similar powers, although these effects have not been generally built upon definite standardized principles. Until the advent of controllable light, the development of the use of the powers of light could not be begun in earnest. Most persons recognize, although vaguely, effects of light somewhat analogous to those of music, but, of course, the two are not simply related, as some persons assume them to be.[1] It is evidence of an extremely superficial knowledge of sound and of light to relate these in any physical manner, such as by wave length or by "vibrations." Still, this is attempted each year by a new crop of amateurs. Light, color, pattern, and music may only be truly related by their influence on human beings—by their psychophysiological effects.

There is a great work to be done in the development of mobile media—light, color, and patterns. Who has not responded to the cheerfulness of a bright sunny morning and has not felt its stimulating influence all day long? On the other hand, who has not felt the depression of an overcast shadowless day? The great symphonies of the sunset hold us enrapt as we witness the benediction of the day. From the ever-changing lighting of a landscape we sense the parade of moods. The play of light from stained-glass windows of a cathedral vitalizes this restful scene. The delicate changefulness of the opal and the restless sparkle of the diamond are examples of melodies of light. On a large scale we have fireworks, making their appeal in a more primitive manner, but still by the powers of light.

In the theater, light may be used to produce different moods. The meager colorless light of the prison, the brilliant sunlight, and the pale light of the moon may play their parts as definitely as other actors. From such realisms to the sparkling colorful lighting effects of fanciful settings and unreal worlds is a gamut of powers of light.

We must feel our way by experimentation in laboratory and in actual interiors. This new art has begun and it should go far. Certainly, we may counteract to some extent the strain of our daily pace by a complementary effect of light. We may use the music of mobile light, color, and pattern to counteract the drabness of this increasing pace. We are going to enjoy mobile light and color in interiors even more than some of us enjoy the sunsets. We are going to use marvelous jewels of light and superdecorative schemes of these mobile media before which the decorator's effort of the present time will be somber and feeble indeed. We will celebrate our emergence from the truly dark ages by festivities of mobile light, color, and pattern. The embryo lighting artist of today will be a superdecorator in the coming era.

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[1] LUCKIESH, M., "Color and Its Applications," chap. 15, D. Van Nostrand Company.

CHAPTER XXI

COMMENTS ON VARIOUS FIELDS OF LIGHTING

It is quite beyond the scope of this book to discuss in detail the various fields of lighting in which science and art may be coordinated to great advantage. However, it should be helpful to include brief comments which indicate the chief principles and opportunities involved and the point of view which may be assumed to advantage. Throughout preceding chapters comments on various lighting fields and on specific problems have been interspersed. In the paragraphs which follow repetition is avoided as far as it seems advisable. One of the primary aims of this book has been to emphasize the depths of the subject of artificial lighting. Those who consider these fields of lighting to be adequately taken care of by means of ornaments with sockets and electric lamps on them possess only a superficial idea of the possibilities of modern artificial light. Such a view is a relic of the age of feeble, flickering flames. Even in that age light was used symbolically—a usage which is now too often overlooked. Those who will broaden their view of artificial light will find a fascinating new field of opportunity for service and expression. Modern artificial light is not only controllable in any desired manner for utilitarian purposes, but it is a medium of expression. By means of it we may introduce much of variety and interest into interiors. In applicability, it is as superior to the artificial light of past centuries as electricity is to the slave power of those darker ages.

RESIDENCES

The scarcity of convenience outlets and the meager wiring in residences inhibit the full utilization of the possibilities of artificial light. Each room should have at least one convenience outlet and most of them should have more than one. In the living room, for example, there should be at least one on each side of the room. The modern duplex convenience outlet is the most desirable one to use. In wiring a residence we should have in mind the convenience which can be obtained in this manner at an insignificant cost. An adequate distribution of outlets, including those for fixtures and switches, frees the householder from many restrictions in locating the furniture. It should be recalled that these outlets are also available for electrical appliances. Finally, it is safe to assume that we are just entering the electrical age and every residence should be wired with increasing use of electricity in mind. An adequate supply of convenience outlets makes it possible to attach portable lamps and wired furniture wherever they may be located. An adequate supply of switches pays many times over in convenience. An adequate supply of outlets for fixtures insures that the desires of others may be satisfied, even though the present landlord or owner does not use all of them. Space does not permit a detailed treatment here, but the subject has been fully discussed elsewhere.[1]

Modern artificial light has made the cellar a part of the home. Many outlets may be conveniently used here. A ceiling fixture of enclosing diffusing glass with a 150-watt daylight lamp makes the laundry and the kitchen places in which to work comfortably. Other shaded light sources in the kitchen, such as one over the sink, add to the satisfactoriness in lighting.

In the dining room we have the specific problem of obtaining primary illumination on the table top, while the faces of the diners are softly illuminated with light of a warm tint. This subject has been adequately discussed in Chap. XVI and many fixture suggestions are presented which supply primary direct lighting as well as secondary indirect lighting and decorative light. Fixtures having two circuits which control two different components make it possible to enjoy variety in lighting effect. The secondary light may be tinted and may be supplied by light sources concealed in architectural features illustrated in Fig. 140. But always the dining table should be the dominant note of brightness. Shaded electric candles are useful and vitalized ornaments for the buffet. Wall brackets are not recommended in the dining room unless they contain well-shaded low-wattage lamps and are used only for secondary lighting. Bright sources in the field of vision are annoying and wall brackets are usually located where the eyes cannot escape them. Walls of low reflection factor, such as stained wood, increase the harshness of lighting. This truth applies to the lighting of any interior.

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[1] LUCKIESH, M., "Lighting the Home," The Century Company.

The living room and similar rooms are the domain of portable lamps. For convenient, comfortable, decorative lighting they are usually superior to lighting fixtures attached to walls and ceiling. As indicated in Chap. XVIII, portables are available for many lighting needs. They possess the advantage of mobility, in that they may be placed in desirable relations to piano, reading table, comfortable chairs, pictures, and other furnishings. Ceiling fixtures may be used if desired for flooding these rooms with light as occasion demands, but "indirect" and open-top portables usually can supply adequate general lighting. Wall brackets should not be considered for the purpose of supplying primary utilitarian illumination. As a rule, they should contain well-shaded, low-wattage lamps and should be considered to be vitalized ornaments, such as the electric candles on the mantel shelf and other "lighted" ornaments.

The chief problem in the bedrooms and dressing rooms is to supply illumination to the person using mirrors. This is best accomplished by two light sources—one on each side of the mirror. These may be portables of proper design or brackets attached to the mirror or to the walls. The advantages of wired furniture and other pertinent details are presented in Chap. XVIII. Some general illumination may be obtained from such lighting equipment, including also a bed lamp or a portable near the bed. If this is not sufficient, a ceiling fixture may be used. Convenience outlets may be attached to the furniture or may be installed in the wall 3 feet above the floor.

Well-shaded 50-watt lamps in brackets—one on each side of the mirror—about 66 inches above the floor usually provide sufficient general illumination in the bathroom as well as at the mirror.

All stairways, halls, porches, and other minor places should be adequately supplied with convenience outlets, fixtures, and switches.

Many exceptional applications of light as discussed in other chapters are possible in residences.

CHURCHES

The use of light in the church has been discussed in various chapters, including Chaps. XI and XVII. There is also much of interest in the ceremonial use of light[1] and, as already emphasized, it is necessary to study the creed and its origins if the lighting is to be done in the most appropriate manner. Most churches are inheritances of the past and some of the roots of the creeds are found in remote antiquity. In so far as the creed, the ceremonies, the architecture, and the furnishings have not been adapted to modern conditions, so may the lighting be made to seem like the earlier lighting. However, this does not mean that the illumination should continue to be inadequate or that the discomfort of bare modern light sources should be endured just because modern sources have been unthinkingly substituted for the feeble flame of the past. In Chap. XVII various suggestions for modern lighting have been incorporated in fixtures which are quite appropriate for churches. The artist fails in his duty if he does not progress in this respect, for in this field his opportunity lies in wedding the new with the old by creating a fixture in whose appropriate exterior modern lighting principles are concealed. Lighting can express the spirit of the creed and this should be a basic viewpoint in church lighting.

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[1] Luckiesh, M., "Artificial Light, Its Influence on Civilization," The Century Company.

So much for the churches which have prototypes in past centuries. We have churches which are products of the present age, as, for example, the Christian Science churches. Certainly, harsh lighting from bare light sources and also walls and ceiling of low reflection factor, such as the dark-stained ceilings in certain other churches, are quite out of key with the creed. The decorative scheme and the lighting of this church is generally as much in contrast with the same factors in churches of older creeds as are the respective creeds. As this church is a product of the present age, it is appropriately illuminated by concealed sources and fixtures which are of low enough brightness to be comfortable to the eyes.

In churches we have domes, arches, columns, vaulted ceilings, and many other definite areas. These may be painted with light in such a manner that the decorative scheme is enhanced by light. Sources may be concealed in architectural details, as suggested in Fig. 140. Suitable fixtures, such as lanterns of appropriate motifs, may provide utilitarian light as well as be suitable from the viewpoint of the creed and the architecture. The dominant illumination may be obtained by the system of indirect lighting, where the ceiling is of reasonably high reflection factor. Where it is not, components of direct lighting should be obtained from fixtures. Where indirect lighting is suitable, there are plenty of opportunities for the use of fixtures in corridors, alcoves, and balconies to satisfy the natural desire for some visible lighting fixtures.

In any church, regardless of creed and of architecture, there are opportunities for progress. Creeds and architecture are fluid to some degree, even in the field of religion, which, perhaps, is the most resentful to change. The church which does not progress goes backward, as does any other civilized activity. Creeds and their ceremonies have undergone many modifications. Why should not the possibilities of modern artificial lighting be drawn upon in the church even beyond those already suggested? Why not utilize the esthetic or, even more broadly, the psychological powers of colored light? Why not draw upon these powers and the established symbolisms in the church? An alcove behind or above the altar or the ceiling itself might be painted with light of a desired color—maybe to simulate the sky or heavens. The lights may be dimmed or brightened or the whole church may be flooded with light of an appropriate tint for certain ceremonies or parts of them. There are various uses for spotlights and flood lights. For example, the altar may be illuminated by such a means to an extent in keeping with its importance. Are there not many uses for light controlled in this manner? It is recognized that these suggestions invade the inalienable rights of the church, but it is also realized that modern artificial light has certain powers and, therefore, it is bound to be used eventually in accordance with these powers.

The structural details of churches vary so widely that it is out of the question to discuss church lighting in detail. Each structure should be studied from a lighting viewpoint and such a study will usually reveal opportunity. For example, Fig. 150 illustrates an excellent grasping of one of these opportunities. The central portion of this church is a huge dome covering a seven-sided auditorium. High up in these walls stained-glass windows are grouped. Lighting equipment is concealed below these windows as indicated, and the artificial light is projected upward and outward through the open sills. This light, coming from a large lamp in a reflector concealed behind the wall beneath each of the twenty-five windows (arranged in groups of five), provides a uniform illumination over the dome and upper walls. This indirect lighting is supplemented by bronze fixtures of censer motif hung in the arches of the balcony. The illustration indicates an exterior wall which contains clear-glass windows. The passageway between the outer and inner walls afforded an easy means of cleaning the lighting equipment and of installing lamps in reflectors for illuminating the stained-glass windows. By using tungsten daylight lamps, the colors in the windows are well revealed and the colder tint of this light contrasts nicely with the warmer tint of the ordinary lamps. As these stained-glass windows are visible at night, their existence is justified perhaps more than is usual in such windows.

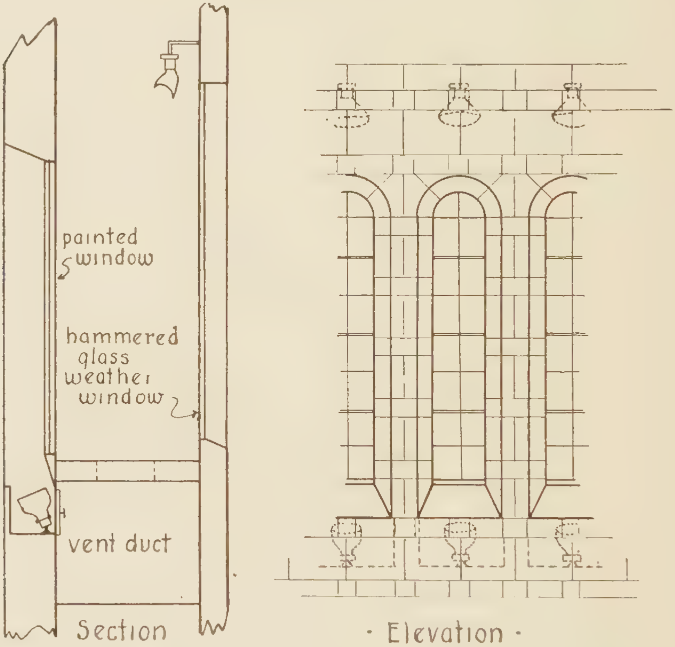

FIG. 150.—Illustrating how indirect lighting was obtained by means of units projecting light through openings in the sills of the inner windows and how these painted windows were illuminated at night by artificial light.

AUDITORIUMS

The auditoriums of theaters and of public halls provide possibilities for utilizing the powers of modern artificial light in increasing interest and in adding variety by means of mobile light. There are many such installations at the present time, so it is needless to discuss them. Here are full-scale laboratories in which the possibilities of various lighting effects are being experimented with. It is true that some of the effects are garish, but the operators must learn to use this new medium. Certainly, many of the effects are fascinating and it must be admitted that much of the interest in these modern auditoriums is due to mobile light. Attempts are being made to harmonize lighting with music. This is a legitimate aim, provided that it is recognized that they can be harmonized only through psychophysiological effects. If a lighting effect and a certain motif of music produce the same emotional effect, why not use them together? Besides theaters, the most notable large installation of mobile lighting is perhaps that in the Public Hall of Cleveland. The cover above the balcony of this large interior contains hundreds of large electric lamps covered with colored glasses. A great portion of the ceiling consists of skylight under an opaque roof. No daylight is admitted, but above this translucent ceiling many lamps with colored-glass accessories are located. By means of elaborate controls, the lighting effect may be greatly varied. In Chaps. XIX and XX various suggestions are found which are applicable to these interiors. The creative artist who thinks in terms of the possibilities of modern artificial light will have no difficulty in devising effective combinations of lighting devices for utilizing the powers of light. Lighting principles applicable to the auditoriums are found in Chap. XV and in other chapters.

It is interesting to note that the designers of the Cleveland Public Hall eliminated the cost of providing daylight and were thus enabled to install an adequate system of artificial light, including mobile lighting, for a cost comparable with the combined cost of meager artificial light and unsatisfactory natural light. In such an interior daylighting is usually undesirable.

BALLROOMS

As stated in Chap. XV and in other chapters, the formal ballroom should be illuminated with fixtures which provide a large component of indirect lighting. This may be done by means of chandeliers with shaded lamps, indirect-lighting fixtures, and in other ways. However, for the best effect in the ballroom there should be a generous sparkle to the effect. In other words, crystalline fixtures, chandeliers with many shaded electric candles, luminous bowls with visible frosted lamps are types of fixtures which supply the sparkle necessary for gowns to glisten and for jewels to scintillate. This does not mean that discomforting glare is permissible. Such a condition will not result from the ceiling fixtures in large rooms if a generous general lighting is obtained by diffusion from the ceiling and walls. Wall brackets should be well shaded.

Even in formal ballrooms colored light and other possibilities of modern light are appropriate, pleasing, and interesting. Figure 151 illustrates a suggestion for such a purpose. The heraldic motif, the visored helmet, and the scroll leaf are characteristics of English Renaissance. The body of the fixture is of crystalline glass, and this is illuminated by a number of lamps in its interior. This provides the desired sparkle. Thirty-three silvered-glass reflectors are concealed in the fixture as illustrated. Most of these may be equipped with standard colored-glass caps as indicated. The lighting effects may be altered by means of dimmers,

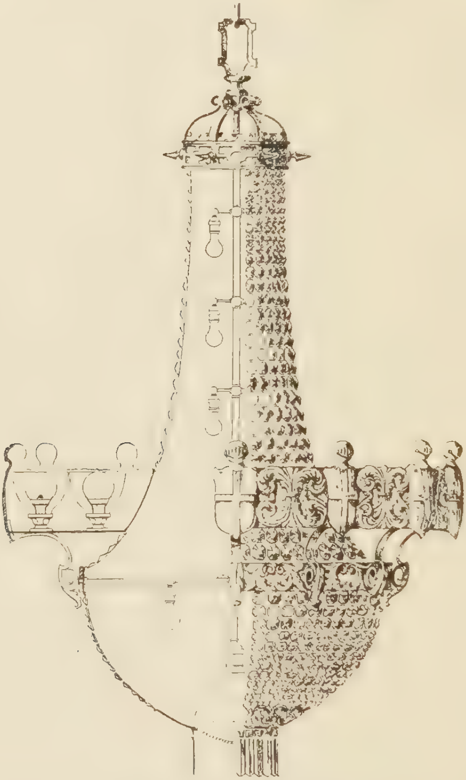

Fig. 151.—An artistic ballroom fixture equipped with color caps installed in indirect-lighting reflectors. A direct-lighting projector is installed at the bottom, for special effects.

but if these are not desired considerable variety may be obtained by adequate switch control. Some of these reflectors provide the desired general lighting, which is colorless. To this may be added as many of the lamps in color caps as desired. In fact, a variety of combinations is possible.

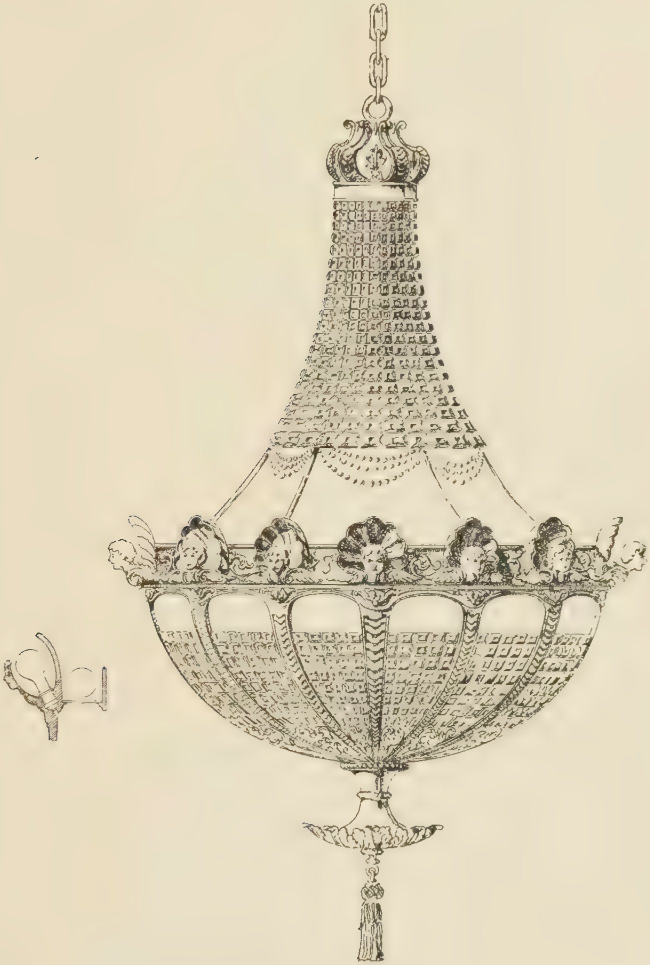

Fig. 152.—A ballroom fixture containing concealed light sources from which various lighting effects may be obtained.

Another interesting feature of Fig. 151 is the spotlight at the bottom of the fixture beneath which is an etched or pebbled crystal glass to conceal the filament of the lamp and to diffuse the light very slightly. This reflector may contain a color cap if desired; however, a pleasing effect can be obtained when this is a beam of colorless light projected downward. With several of these fixtures emitting downward beams of light and the rest of the room flooded with tinted light of a low intensity of illumination, the result is pleasingly novel. There are many possibilities from such a fixture and it may be of sufficient formality and artistic value to do justice to the most exquisite ballroom.

Another fixture which provides sparkle in the same manner as Fig. 151 is illustrated in Fig. 152. The shell, cupid's head, and defined leaf give to this design the spirit of the Louis XIV style. Electric lamps are concealed behind the cupid heads and the light is reflected from the polished metal shells. Electric lamps are also concealed in a trough in the interior of the reflector. This trough may be enlarged, so that caps or plates of colored glass could be used. Otherwise, if colored light is desired, the lamps must be tinted. Some superficially tinted lamps are obtainable which are quite permanent as to color, but most of the superficial coatings are not permanent enough to pay for their use, except, possibly, on vacuum tungsten lamps.

Of course, spotlights and flood lights with and without color filters may be located anywhere in the room. However, the solution presented by Figs. 151 and 152 (particularly the former) is notable in that all equipment is concealed in a fixture which may be as formal and as elaborate as desired.

Dance halls provide a greater range of lighting expedients than the more formal ballrooms. They may vary so greatly in design that it seems futile to attempt to discuss them in detail. Many of the suggestions in Chap. XX as well as in other chapters are applicable to this type of interior. It seems well to make lighting one of the attractive features of such an interior. This may be done by striving for many lighting effects of distribution and color. Light sources may be concealed in many places and certain "scenic" effects may be introduced. A changing sky overhead and certain effects behind lattice work are sometimes appropriate. Transparencies of changing color and a reasonable amount of sparkling effect may be suitable. A palace of lighting effects is quite in keeping with the spirit of the more elaborate dance halls. With all these and many other lighting expedients the lantern is still a valuable adjunct.

A Japanesque lantern is illustrated in Fig. 153. In the upper part of this may be installed many lamps in color caps inside of efficient reflectors. With proper control, the interior may be flooded with light of the desired tint. Reflectors which concentrate the light more or less in beams are installed in the bottom of the lantern. The apertures of these reflectors may be covered with color filters, or color caps may be used. The panels of the lantern are illuminated by means of a few lamps, as shown in the central portion. Such a lantern embodies within it enough equipment for controlling the distribution and color of the light to provide a great variety of lighting effects. With ingenuity

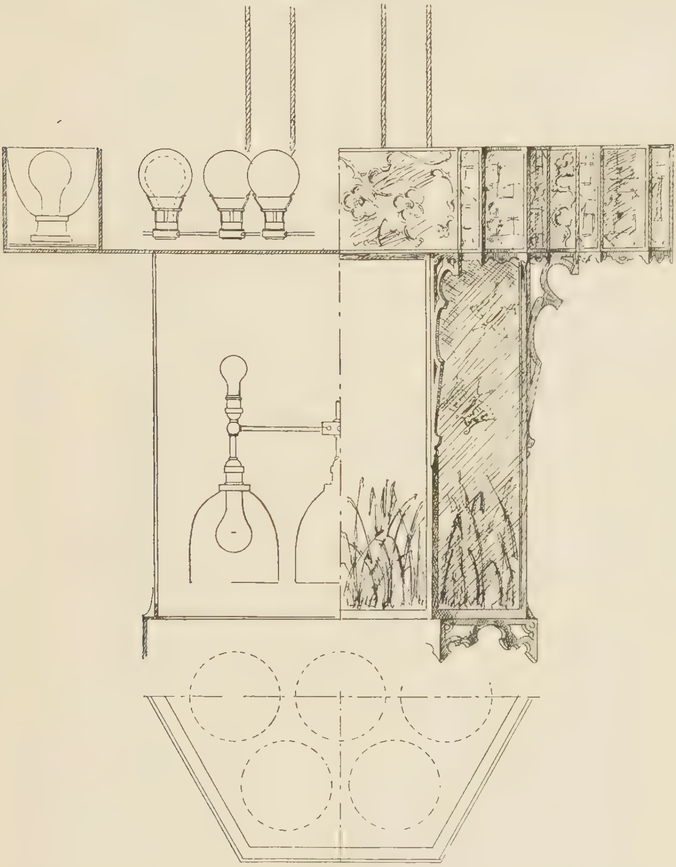

Fig. 153.—A fixture suitable for a dance hall and other places where lighting effects are desired. Color caps are installed in indirect-lighting reflectors and direct-lighting reflectors are located as indicated.

expended on such lanterns and with an adequate number of circuits and dimmers a lighting installation of great potentiality is obtained at a reasonable cost.

RESTAURANTS

Restaurants may be divided into two classes analogous to ballrooms and dance halls. In the formal dining room of hotels and clubs a certain degree of color effect may be utilized, but the colors should be delicate tints. For this purpose a flame-tinted lamp is available. A tint may be obtained by mixing light of a pure color with ordinary light in the desired proportions. Furthermore, color in the shades of the fixtures does much toward providing the desired tint.

As an example of the importance of the tint of the light, let us discuss briefly the situation in one of the finest hotels in this country. The dining room faced a large body of water and through its generous windows one could see a beautiful landscape with the expanse of water in the background. During the day this beautiful decorated and furnished interior was quite pleasing. There was a coolness in the effect which was quite in keeping with the visible outdoors. However, at night the coldness of the interior persisted and it is well established that we like warm tinted surroundings at night. We are dual personalities in respect to light. A cold daylight seems natural to us in the daytime, but the light of flames is more suitable at night.[1] The solution of this problem, which was so perplexing to the operators of the hotel, was achieved by using flame-tinted lamps in the crystalline chandeliers. Now, this dining room is satisfactory at night as well as by day.

There should be a degree of sparkle in the lighting of formal dining rooms for the same reason that it is desirable in ballrooms. This is furnished by multiple light sources which are delicately shaded. Exposed frosted lamps should not be used in such rooms where persons are obliged to sit in one position for an hour or more. Although there is not the same demand for light localized on the table in public dining rooms as in the residence, small portables usually produce a pleasing effect by enhancing the illumination at the table.

In many of the less formal dining rooms and restaurants a low intensity of general illumination and portable lamps on the tables

[1] Luckiesh, M., "Light and Work," D. Van Nostrand Company.

provide the quiet cozy effect desired. In many restaurants where the spirit of the interior is more lively, a variety of effects, including color effects, are quite appropriate. The suggestions in Chap. XX and even those for dance halls may be drawn upon. Many of these have been treated elsewhere[1] for restaurants, show windows, and distinctive shops.

DISTINCTIVE SHOPS

Many opportunities for combining artistic and scientific lighting are to be found in the distinctive stores and shops. The exterior of fixtures can be such as to be quite appropriate for any specific shop, still it may conceal lighting equipment which provides the distribution of light desired. Many shops should be illuminated by means of tungsten daylight lamps and the coldness of this light may be camouflaged by having the fixture itself appear of a warm tint. All our knowledge of the effectiveness of color and of the control of the quality and distribution of light may be drawn upon to utilize the attractiveness and the selling force of lighting. Distinctive shops range from the dignified formal establishment of the high-class jeweler or modiste to those of freer spirit, such as the refreshment parlor. Here we have opportunities for the whole gamut of lighting possibilities. In some shops, such as those displaying jewelry and gowns, a generous amount of sparkle should be combined with adequate general illumination. Various fixture suggestions already presented are available for such places. The lighting effects in other shops may run to the other extremes. Here again the variety of requirements make it impossible to treat them within the space available. If the lighting specialist, architect, or consumer will study the possibilities of light deeply, no difficulty will be found in harnessing the marvelous mediums of artificial light to the task of making shops attractive as well as providing utilitarian lighting.

SHOW WINDOWS

Show windows offer wonderful opportunities for using the powers of light. Certainly, novelty, attractiveness, and, therefore, pulling power may be introduced by means of lighting effects. The show window is a stage setting and all the possibilities of stage lighting are awaiting application in this field.

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[1] Luckiesh, M., "Light and Color in Advertising and Merchandising," D. Van Nostrand Company.

Recounting all these would result in a list of all the lighting effects possible. The display man should be a lighting artist. He should become familiar with a variety of available equipment and he should study the depths from which light has gained its powers. The early chapters provide foundations of such knowledge and the reference in the preceding section will aid him in adding light to his display materials. Here we have space only for some general suggestions.

In order to obtain lighting effects conveniently, the show window should be equipped permanently with certain devices.

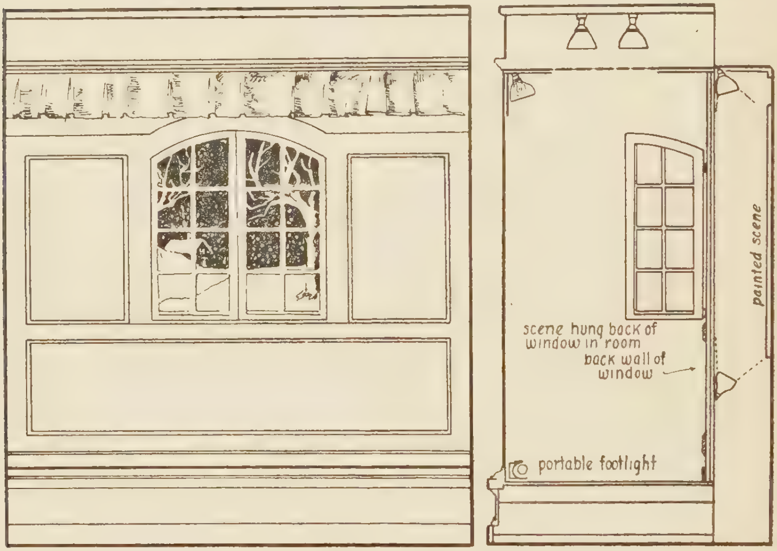

Fig. 154.—Illustrating an installation of unusual equipment for a small show window. Besides the usual top lights, a row of footlights is available and a painting on a second background is illuminated so as to be seen through the unglazed window in the first background.

A small show window of many possibilities is illustrated in Fig. 154. The setting of the window is that of a room of the home. To carry out the spirit of such a room, wall brackets (and even portable lamps) may be used. A window (without glass) is located in the background. As seen in the vertical section, a painted scene is placed about 3 feet distant (depending on the size of the window) on another background behind the first one. This scene may represent a season or a place of interest in connection with the merchandise. A gauze curtain or vines hanging down outside obstruct vision sufficiently so that the illusion of an actual scene is enhanced. When furs are shown in August, an interesting winter scene may be illuminated with light of a cold tint. This scene is suggestive of the need of furs. Many other ideas may be used. As seen in the illustration, footlights are installed as well as top lights. By using color caps a flood colored light may be obtained. If a tinted light is desired, this may be obtained by using color caps in some reflectors and none in others. The footlights are not only useful in illuminating the shadows, but also in obtaining striking color effects. Translucent panels are set in the ceiling. These have some possibilities in the show window, but only for secondary lighting. A flood of colored light may be used along with colorless spotlights for

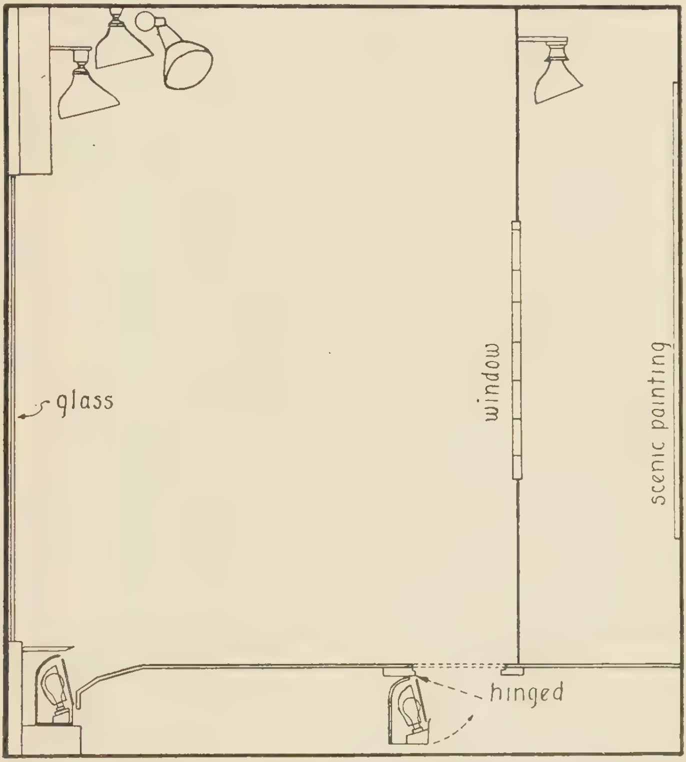

Fig. 155.—Illustrating unusual equipment in a show window. Top lights, spotlights, two rows of footlights, and a second background for an illuminated scene are indicated.

bringing out any particular object. Many of the possibilities discussed in Chap. XX and in other chapters are applicable to this field of lighting.

More elaborate equipment is illustrated in Fig. 155. Two rows of reflectors are installed in the upper front of the window. These make it possible to have four permanent circuits, three of which may be equipped with color caps. Spotlights may be fastened to the ceiling as shown or concealed behind merchandising or display equipment. The footlights consist of metal housing containing silvered reflectors and colored-glass plates. Another row of these footlights is shown near the back of the window. A strip of the floor is removable and, the metal housing being hinged, these footlights may be swung upward into the desired position. They are particularly effective in confining light to the background for producing unusual effects. This background could be a "metallic" or an ordinary textile curtain. A window is located in the first background and a painting is fastened in the background behind this. The painting is illuminated as indicated. It need not be fastened only to the background. If the window is of large area, the painting may be hung in an arc, so that it will intercept a view through the window from even the extreme positions of the observer at the side. The remaining space between the two backgrounds may be used for equipment for illuminating transparencies on each side of the window in the first background. Many other provisions may be made, but the equipment indicated in these illustrations makes possible effects far more striking and attractive than those in the usual window. The first background may be constructed so as to be removable, thereby making it possible to utilize the entire window when desired. It is obvious that one advantage of the second background is the ease with which one lighting effect may be confined to the window display and another to the scenic background. The back row of footlights provides such an advantage to some extent.

MUSEUMS

Objects in museums owe their distinction to their appearance, for it is through the visual sense that they are appreciated. This means that light is essential, but it also means more, because the appearance of an object depends largely upon its lighting. This statement is made with cognizance of the fact that art "appreciation" in some cases springs largely from cost, possession, rarity, and antiquity, but certainly this is not true esthetic appreciation. In order to justify museums, the value of the objects must be based largely upon their appearance. Any museum which houses collections of artistic or historic interest having little value except that arising from the visual sense is a monument of hypocrisy in proportion to the neglect of the lighting of the objects within it. Likewise, art appreciation becomes a sham if the objects are illy lighted; still, most museums are very inadequately and improperly illuminated. In fact, museums do not expend time, money, and ingenuity in lighting at all commensurate with its importance, considering the value of the objects which they house and the value of the building itself. One may readily conclude that those responsible for museums either are grossly negligent in their responsibility or are misers who gain their satisfaction largely through possession. The problems of lighting found in museums are so manifold that a volume could be devoted to their discussion. Here we have space for only a few remarks, but these in conjunction with material in other chapters should be helpful to anyone confronted with lighting problems in the museum.

Displays in cases are easily illuminated with satisfaction. Depending upon the size of the display, showcase or show-window lighting may be applied. In the museums of natural history, there are many large cases which could be located and illuminated like so many show windows. By confining the primary lighting to sources in the cases, each exhibit could have its own lighting specifically designed for it as to intensity, direction, and quality of light. Here is ample opportunity for all the skill of a lighting specialist. The colored-glass accessories may be utilized to obtain the variety of lighting effects which displays of this sort require.

The architect and the lighting specialist have an excellent opportunity for cooperation in museums. The architect and the museum officials will find that the lighting specialist may bring out many ideas of value. In the first place, natural light should not be admitted in many museum galleries, owing to its cost, inefficacy, undependability, costly maintenance, and destructive fading. By expending the money which is ordinarily invested in daylighting in artificial lighting together with that which would be invested in mediocre artificial lighting, excellent artificial lighting may be obtained quite free from the disadvantages of natural lighting. Where it is easy to install windows and where they will not be a disadvantage, they may be used chiefly for "letting vision out." This may seem like heresy, but if the prejudices of habit will be eliminated it will be seen that these statements are supported by facts. In general, the tungsten daylight lamp is quite satisfactory as to quality of light, and artificial light may be completely controlled as to quantity of light. Where a special quality of light is desired, such as is required by certain displays, various effects of moonlight, cold winter daylight, tropical sunlight, etc. are readily obtained by means of the colored-glass accessories.

In the paintings' gallery the light should be so distributed that the hanging area on the walls receives as much, and preferably more, light per unit area as the floor. This cannot be achieved by an overhead skylight admitting daylight. If louvers are installed, as in the Cleveland Museum of Art, this condition may be approached. The dominant light should reach the paintings at an angle approximating 45 degrees, so that images of the light sources are not reflected into the eyes of the observer.[1] A simple diagram may be drawn utilizing the optical relation of equal angles of incidence and reflection. If natural light is to be used, clearstory windows high in the walls (height above the floor being at least as great as the width of the room) may be used. The windows near the ceiling on one side illuminate the opposite wall primarily. Such windows may contain lighting equipment which projects light downward to the lower portion of the opposite wall. Likewise, small skylight areas may be installed in the ceiling and projectors of artificial light may be located above them. In these cases a pebbled or ribbed crystal glass should be used rather than a more diffusing glass. Artificial "clearstory" windows were devised by Ward Harrison and the author as a solution for the large paintings' galleries in a projected museum. The general idea is illustrated in Fig. 156. The various "lines of light" may be followed before and after reflection by the letters. The vertical and horizontal scales of feet are also useful. An enclosure is shown for use when no daylight is admitted. In many cases there might be other rooms adjacent, so that daylight could not be admitted in this manner.

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[1] Luckiesh, M., "The Lighting Art," McGraw-Hill Book Company, Inc., *Architecture*, vol. 48, p. 416, 1923; vol. 49, p. 57, 1924.

Figure 157 illustrates a narrow strip of ceiling glass. Above this in a compartment (painted white inside) parallel to the glass are reflectors which project light as indicated. The glass may be confined to a smaller area or even individual glasses may be supplied for each pair of projectors. This glass need not be horizontal, for, if the architect can design a satisfactorily appearing structure extending below the ceiling, the same principle might be used. In other words the illustration is introduced to amplify a trend of thought.

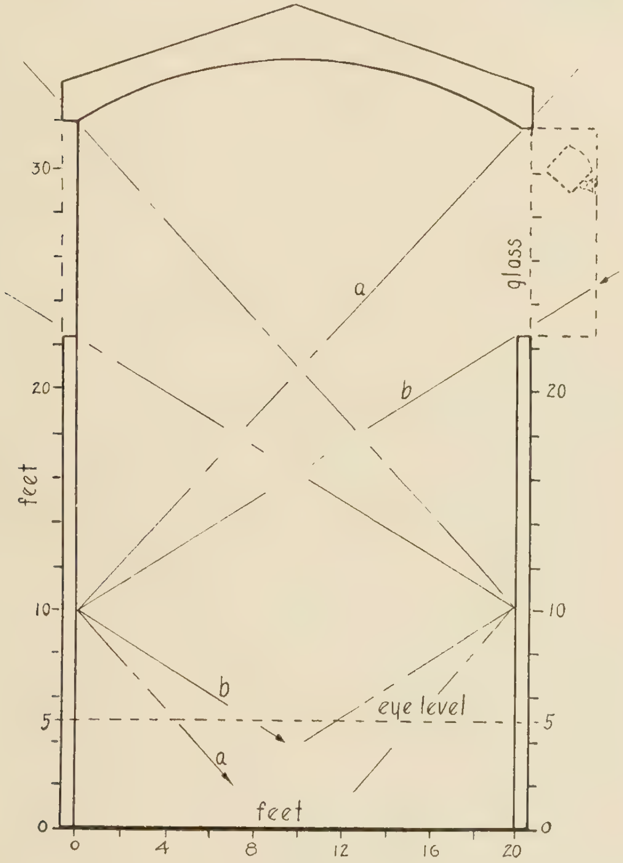

Fig. 156.—Illustrating natural and artificial clearstory windows for a paintings gallery and other interiors in which the lower areas of the walls, primarily, are to be illuminated.

In Chap. XVII a number of fixtures are illustrated which are applicable to museums.

Figure 158 presents a radical idea and, to carry it out, an architect must be independent of tradition and the structural conditions must be such that there would not be too much wasted space in the building. The general idea is to supply an alcove along the sides of a room. This alcove may or may not have partitions and a balustrade and columns may or may not be used

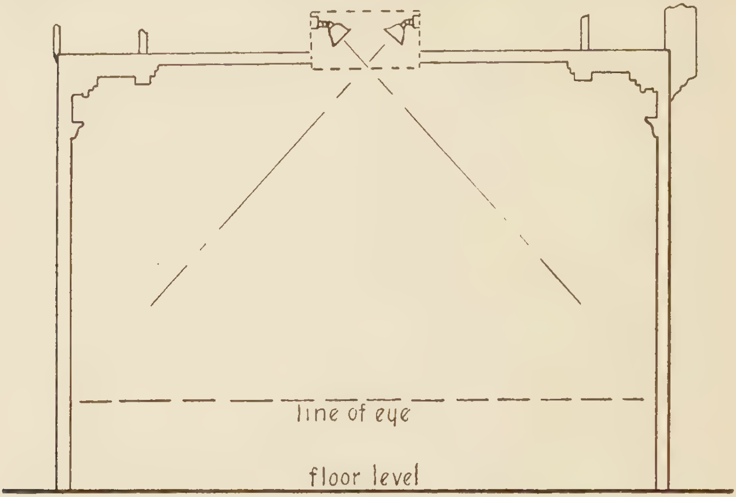

Fig. 157.—Indicating a strip of skylight with artificial-lighting equipment installed above it for illuminating the walls.

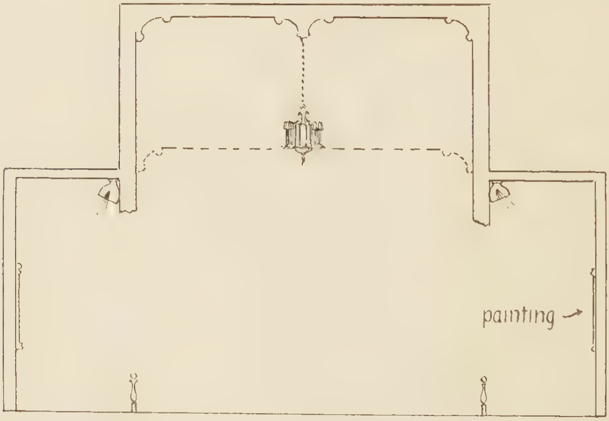

Fig. 158.—A suggested design of an interior in which paintings and other exhibits could be installed and illuminated like show windows around the sides of a room. The ceiling of the central portion may be high or low, as desired. Some general lighting may be obtained by means of chandeliers.

in the front plane of the alcove. The pictures would be illuminated by lamps in reflectors similar to those in the upper front of show windows. Some general illumination may be supplied by decorative fixtures hanging from the ceiling. It seems possible that the architect could incorporate this idea or modifications of it in certain paintings' galleries in museums. It would be ideal in some respects for displays in museums of natural history.

Many details have been purposely omitted in these brief discussions, but attention is called to the importance of many apparently minor details.

Sculpture is well illuminated in a manner simulating a hazy day. Under these conditions the dominant light is still provided by the sun (tempered by the haze), but the great solid angle of the sky provides much general illumination, so that the shadows are not harsh. It is easy to imitate such a condition indoors by having a large component of indirect light added to the direct light from a diffusing envelope of glass, such as a large sphere containing light sources. This could be satisfactorily accomplished in a large room in which the sculptures are arranged around the sides of the room and facing inward. The niche or alcove may be used and the lighting of each carried out in the best manner. However, practical conditions often require the grouping of such objects and the "sun-sky" lighting is much better than multiple light sources which cause multiple shadows.[1]

As already stated, the museum offers a great variety of lighting problems which, owing to value of the objects and the importance of their appearance, are worthy of the greatest skill of the lighting specialist. Artificial light is bound to supercede natural light in museums when the prejudices of tradition and the indifferences of habit give way to a proper view of the advantages of artificial over natural light in most cases.[2]

FLOOD LIGHTING

Flood lighting of buildings, monuments, and other structures calls for a combination of artistic and scientific skill. As with painted windows, such structures should have a greater "load factor of visibility." Why should they retire into the darkness when artificial light can do so much to make their magnificence available at night? Much flood-lighting equipment is available, and if the architect will plan this lighting during the design of the building many difficulties are eliminated. Perhaps the greatest problem in flood lighting is in locating the lighting equipment. Furthermore, the light usually must be projected upward, thus reversing the shadows. Nevertheless, this is not always objectionable, as is evidenced by some very attractive flood-lighting installations.

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[1] Luckiesh, M., "Light and Shade and Their Applications," D. Van Nostrand Company.

[2] Luckiesh, M., "Light and Work," D. Van Nostrand Company.

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